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CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

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CHRISTMAS.

This is the week before Christmas—the holiday that brings good feeling and marks the close of the year, when we all sit down to a pleasant indulgence of reminiscence and anticipation. This year Christmas should be a merry one to the personnel of the electrical industry in this country. Never before has the close of a year of work shown better progress, more earnings or a brighter outlook. It needs no mistletoe and holly, no plum-pudding or elephantine turkey to make us happy. And we can all afford punch if we want it.

To all its readers the ELECTRICAL REVIEW wishes the merriest of Christmases, the biggest of turkeys, the gayest of parties and the brightest of New-Year outlooks.

THE ELECTRICAL TERMINAL SYSTEM OF THE PENNSYLVANIA RAILROAD.

Official announcement was made last week of the plans of the Pennsylvania Railroad Company to construct in New York an underground terminal system of the most interesting type and on a gigantic scale, using electricity as the motive power for its trains in the long tunnels and subways necessary. The details of the proposed installation are set forth at length elsewhere in this issue.

To those of us who have waited and hoped for this change it seems almost too good to be true. In brief, the system contemplates a subway constructed in tubular tunnels, beginning at a point near the North River, in New Jersey, continuing under that river to a large terminal station centrally situated in the Borough of Manhattan, continuing thence across Manhattan Island and under the East River to a great open-air terminal station in Brooklyn, and there connecting with the entire system of railways of Long Island. Electrical operation is a necessary feature of the system for obvious reasons.

Leaving out of consideration the enormous advantages which will accrue to the city of New York from the construction of this splendid work, a number of most interesting speculations can be indulged concerning the extent to which electric traction will be made use of in connection with the new installation. It is, of course, certain that the whole of the section from Brooklyn to the tunnel mouth in New Jersey must, of necessity, be operated by electricity. The first question that presents itself is, How much further will the electrical service be extended, and why should not it be extended immediately to Philadelphia, at least, on one side, and to the main traveled sections of the Long Island railroads through the western half of the island on the other?

It is certain that the engineers who have designed this highly creditable piece of work must have been impressed with the advantages of electric traction for at least the suburban service of the railroads which will occupy the new system. The question of suburban service when electrical operation is in consideration includes the definition of suburbs. Without any aspersion upon the independent character of Philadelphia, may not that city be regarded properly, in this connection, as a suburb of New York, and would not the benefits derived from electrical service to Elizabeth, for example, be even more important if this service should be extended to Philadelphia?

And if to Philadelphia, which is itself a suburban centre of no small importance, why not to Baltimore, or to Washington, or to Pittsburgh? Is not this terminal the first and most important step that has yet been taken in the direction of the electrical equipment of main-line railways? It will be believed, at any rate, throughout the electrical field that such is the case, and it seems safe even now to hazard the prediction that the experience which will be derived by the Pennsylvania Railroad in the operation of this new extension will give the data for electrical extension, not only to all of its own passenger service, but to that of all the other railroads coming into New York, and, eventually, into other large cities of this country. To put it in another way, we are now assured of electric traction on main-line railways. It is pleasant to know that the railroad corporation undertaking this epoch-marking improvement is one that has always maintained an admirable standard of service, and one that has exhibited the progressive spirit that is an earnest of good things to come.

Street signs, sadly needed for years, are to mark the street corners in New York early next year. A good opportunity for an inventor is to be found in designing an electric lighted sign readable at night.

HIGH AND LOW-TENSION WIRES IN THE SAME CONDUITS.

On another page of this issue will be found an article by Mr. Charles F. Hopewell, city electrician of Cambridge, Mass., in which the author takes issue with the recently published address of Captain William Brophy, wherein was set forth the dangers incident to the simultaneous operation of high and low-tension circuits in the same conduit system.

Mr. Hopewell cites some extremely interesting figures and facts, but he appears to have lost sight of what is, after all, the principal point in the situation, and this is the simultaneous occupation of manholes and other restricted spaces by wires carrying currents of widely different character. The subject is one of extreme importance, since the present attitude of a good many municipal governments is to attempt the enforcement of a joint occupation of conduits upon such diverse interests as electric light, street railway and telephone companies. If there were only one class of service, then, as Mr. Hopewell points out, the duplication of conduits would be unquestionably an economic mistake; but where the nature of the circuits to be put underground is such that they mutually interfere with one another and may effect each other's destruction under given circumstances, then it seems not only good engineering but plain common sense to keep them mutually out of reach.

The general service of a telephone company, for example, in a city ramifies into an enormous number of buildings and comes into actual physical contact all of the time with a considerable number of people. To expose such circuits as these to the possibility of contact with high-potential lighting or power circuits is an invitation for a series of disastrous accidents, and might furnish a coroner's jury, under some circumstances, with grounds for a verdict of criminal negligence. If there were no such things as manholes, and the question were simply one of putting ducts for these services in the same trench and running the cables alongside of one another, even for considerable distances, it would seem that no very serious objection could be urged to the practice. But, unfortunately, no conduit system is continuous. All have frequent openings in which men, from time to time, have to work, and it is at these points—the manholes—that trouble may be expected to happen.

In more than one instance an electric lighting company has seen fit to lay its conduits, including its manholes, upon a duplicate system, not bringing all of the cables of a given line at any point through the same manhole, in order to minimize the chances of accident and the destruction of continuous service which the joint use of manholes by all cables imposes. If this is found to be worth doing by intelligent engineers of long experience with underground work in the case of a company whose circuits are all of one kind, how much more evident is the necessity for the separation of circuits of totally different kinds, whose mutual crossing might produce disastrous and widespread calamity?

The subject is one that invites full discussion, and it is hoped that the two papers referred to above, each of which ably maintains its own side in this controversy, may be productive of further discussion and enlightenment upon a subject which has lately become an occasion for no little foolish interference on the part of municipal authorities with conditions they do not fully understand.

Some very interesting facts have turned up in connection with the specifications of the United States Navy Department in regard to enclosed direct-current motors for use on board ships. Certain conditions of efficiency and output were laid down for enclosed motors which departed so widely from the specifications found advantageous in work ashore as to require often the use of a motor frame anywhere from two to three times as large as would be called for in ordinary commercial practice to develop the same power. It is believed that the matter of these specifications will be taken up, and that the department's rulings on the subject will be changed. Meanwhile the existing specifications have made it very difficult for manufacturers to comply with the conditions laid down in all respects and it is to be hoped that they will be altered to conform more nearly to what experience has demonstrated to be good practice in commercial work.

THE ELECTRICAL PRESS.

Very few people in the electrical industries in the United States have stopped to consider the service that has been rendered them by the electrical press. With all deference to the requirements of a becoming modesty, it does not seem amiss to call attention to the great service that has been rendered the industry at large by the several excellent weekly publications dealing with electricity and mechanics. These journals have no rivals in the whole field of the technical press, either for their mechanical perfection, the care with which they are edited, the completeness with which they cover the field of their effort, or the value of the articles printed in them. The educational importance of these journals can hardly be over-estimated. From week to week they exhibit the advance of the art in all its branches, and they form a forum for discussion which has been of immense value in enlightening the members of the profession and the electrical trade upon all the points connected with their business. Almost nowhere is the power of the press better illustrated than in this field, yet it may be said for the credit of American technical journalism that this power has practically never been abused, and that the electrical profession in the United States is perhaps better served by its press than is any other engineering profession anywhere in the world.

It is stated that good progress has been made in the construction of the Cape-to-Cairo telegraph. In nearly all cases the telegraph has been the forerunner of civilization, and even in "Darkest Africa" it would seem that there is great hope for the future. The next news will probably be that the electric railway is following closely upon the heels of the telegraph.

Next summer will mark the one hundred and fiftieth anniversary of the flight of Franklin's kite. Why should not the electrical fraternity signalize it by erecting a tablet in Philadelphia to mark the historic spot?

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—L.

BY W. ELWELL GOLDSBOROUGH.

If we lay off now on OC_{2-8}^{I} the vector $OC_2^I = I_2$, $r_2 = 30 \times 6.66 = 200$ volts, and at C_2^I erect the perpendicular $C_2^I A_8^I = I_2$, $x_2 = 30 \times 1.18 = 35$ volts, we will have located the phase positions of the vectors OA_8^I and $A_8^I A_7^I$. Accordingly, the vector $OA_7^I = 203$ volts is the electro-motive force apparent at the terminals of the circuit A_2A_8 under these conditions, and the vector $A_8^I A_7^I = 806$ volts the electro-motive force apparent at the terminals of the circuit A_8A_7. Applying the same construction to the circuits $A_7A_9A_3$, since they have a total resistance of 29.4 ohms, and a total reactance of 7.3 ohms, we find that a current equal to $OB_7^I = 33$ amperes will be set up in them, that an electro-motive force $OA_3^I = 224$ volts will be apparent at the terminals of the circuit A_3A_9, and that an electro-motive force of 776 volts will be apparent at the terminals of the circuit A_7A_9.

Now, the resultant of the currents in the parallel circuits gives us the vector $OB_1^I = 62.6$ amperes as the current to be forced through the line A_1A_7 and the armature circuit of phase E^I. Since the resistance and reactance of the circuit A_1A_7 are known, we find that a pressure of 424 volts, equal to the vector $A_7^I A^I$, will be needed. Now, taking the resultant of the vectors OA_7^I and $A_7^I A^I$ we find that the phase E^I must develop 1,418 volts in order that a potential of 1,000 volts shall be maintained upon the parallel part of the system. The complete data covering Fig. 122 are given in table 15.

TABLE 14.

Data pertaining to Fig. 120.

Circuits. See Fig. 119.	Impressed E. M. F. E	Resistance E. M. F. E_r	Reactance E. M. F. E_x	Current Amperes. I	Power absorbed Watts. P	Circuit Constants. Ohms. r	Ohms. x	Ohms. z	Degrees. ϕ
A_1A_7	533	512	142	39.8	20,400	12.9	3.6	13.4	16
A_2A_8	374	370	56	25.9	9,580	14.3	2.2	14.5	9
A_3A_9	692	640	264	14.0	8,820	45.7	18.9	49.5	22
A_7A_9	660	270	478	25.9	7,510	10.4	18.5	25.5	58
A_8A_7	846	512	673	14.0	7,170	36.6	48.1	60.4	53
A_9A_8	325	312	87	12.0	3,740	26.0	7.8	27.1	15
E^I	1,672	1,439	846	39.8	57,220	36.2	21.3	42.0	30

In Fig. 123 we have presented the graphical diagram which shows the value of the currents and electro-motive forces due to phase E^{III} acting alone. When E^{III} only is active, the circuit A_3A_9 is in series with the circuits $A_9A_7A_1$ and $A_9A_8A_2$ and the presence of the circuit A_7A_8 is neglected; therefore, a current equal to $OB_7^{III} = 33$ amperes will be set up through the circuits $A_9A_7A_1$, when E^{III} is maintained at such a value that 1,000 volts is apparent at the terminals A_9 and A_1. A current equal to $OB_9^{III} = 27$ amperes will flow through the circuits $A_9A_8A_2$. The resultant of the currents in the parallel circuits gives the current $OB_3^{III} = 58.2$ amperes to be forced through the line A_3A_9; therefore, the maintaining of these conditions by phase E^{III} will require that it develop 1,380 volts. Complete data covering this case are given in table 15.

TABLE 15.

Data pertaining to Figs. 122, 123 and 124.

Circuits. See Fig. 117.	Impressed E. M. F. E	Resistance E. M. F. E_r	Reactance E. M. F. E_x	Current Amperes. I	Current Sag in Degrees. ϕ
When only phase $E^I = 1,418$ volts is active.					
A_1A_7	424	417	75	62.6	10
A_2A_8	203	200	35	30.0	10
A_3A_9	224	220	39	33.0	10
A_7A_9	776	748	202	33.0	15
A_8A_7	806	677	436	30.0	33
When only phase $E^{II} = 1,355$ volts is active.					
A_1A_7	203	200	35	30.0	10
A_2A_8	384	378	67	56.7	10
A_3A_9	183	180	32	27.0	10
A_8A_7	806	677	436	30.0	33
A_9A_8	849	559	637	27.0	49
When only phase $E^{III} = 1,380$ volts is active.					
A_1A_7	224	220	39	33.0	10
A_2A_8	183	180	32	27.0	10
A_3A_9	394	388	68	58.2	10
A_7A_9	776	748	202	33.0	15
A_9A_8	849	559	637	27.0	49

Finally, when phase E^{II} is acting alone and given such a value as will maintain the pressure of 1,000 volts between the terminals A_8A_1 and A_3A_3, the following conditions exist. Since the presence of the circuit A_7A_9 is neglected, the current which will flow through the circuits $A_8A_7A_1$ is $OB_8^{II} = 30$ amperes, and the current which will flow through the circuits $A_3A_9A_3$ is $OB_9^{II} = 27$ amperes. The resultant of these currents is $OB_3^{II} = 56.7$ amperes, and this current must be forced through the line A_3A_8. The maintaining of these conditions will require the development of 1,355 volts by phase E^{II} of the alternator. The complete data of Fig. 124 are given in table 15.

A final solution of this problem requires that the diagrams contained in Figs. 120, 123 and 124 should be grouped together. Before doing this, the vectors of these figures must be so changed as to be comparable with one another. To bring the vector OA^I of Fig. 122 into comparison with the vectors OA^{III} of Fig. 123, and OA^{II} of Fig. 124, it must be reduced in the ratio of 1,200 to 1,418. The reduction of Fig. 122 in this ratio gives the values tabulated in table 16. Correspondingly, the vectors of Fig. 123 must be reduced in the ratio of 1,200 to 1,380, and, finally, the vectors of Fig. 124 must be reduced in the ratio of 1,200 to 1,355. The result of these reductions gives data also tabulated in table 16.

TABLE 16.

Data pertaining to Fig. 125.

Circuits. See Fig. 117.	Impressed E. M. F. E	Resistance E. M. F. E_r	Reactance E. M. F. E_x	Current Amperes. I
When only phase $E^I = 1,200$ volts is active.				
A_1A_7	359	353	65	53.0
A_2A_8	172	169	30	25.4
A_3A_9	190	186	33	28.0
A_7A_9	657	633	171	28.0
A_8A_7	683	574	370	25.4
When only phase $E^{II} = 1,200$ volts is active.				
A_1A_7	195	191	34	28.7
A_2A_8	159	156	28	23.5
A_3A_9	342	337	59	50.6
A_8A_7	675	650	176	28.7
A_9A_8	486	486	554	23.5
When only phase $E^{III} = 1,200$ volts is active.				
A_1A_7	180	177	31	26.6
A_2A_8	340	335	59	50.3
A_3A_9	162	159	28	23.9
A_7A_9	712	599	386	26.6
A_9A_8	751	495	564	23.9

In Fig. 125 we have the reduced phase diagrams grouped together in such a way that a phase difference of 120 degrees exists between the impressed electro-motive-force vectors OA^I, OA^{II} and OA^{III} representing the phase electro-motive force E^I, E^{III} and E^{II}. This arrangement of the three sets of vectors makes it possible for us to readily determine the final resultant electro-motive force or current that is active in any part of the circuit, since it admits of our taking the sum of the forces active in each part of the system when the three phases are separately impressed. For instance, the final electro-motive force that will be apparent at the terminals of the line circuit A_1A_7, when all three of the phases are active, is equal to the vector sum of the vectors $A^I A_7^I$, $O'A_7^{III}$ and $O'A_7^{II}$. This vector sum is taken by laying off from A_7^I the vector $A_7^I A_1$ equal and parallel to $O'A_7^{III}$ and the vector A_1A_7 equal and parallel to $O'A_7^{II}$. The vector distance, $A^I A_1 = 574$ volts, is then the potential required.

In the same way the final pressure appearing at the terminals of the circuit A_7A_8 is determined as the resultant of the vectors $A^{II}A_8^{II}$, $O'A_8^I$ and $O'A_8^{III}$. This resultant is equal to the vector distance $A^{II}A_8 = 541$ volts. The pressure finally appearing at the terminals of the third line, A_3A_9, is equal to the vector $A^{III}A_9 = 450$ volts.

Science Brevities

Preservation of Standard Magnets—Since the discovery of the new magnetic steels permanent magnets have been made which keep a constant moment for a whole year within 0.1 per cent. The question as to the best means of storing them when not in use is raised and answered by Herr Klemencic in an article published in the *Annalen der Physik*, which is abstracted in the London *Electrician*. He encloses the magnet in a glass tube filled with cotton wool, which in its turn is embedded in an iron box with sides three mm. in thickness. This prevents both disturbances by jarring and by an external magnetic field. He finds that the protection ratio is three. This is not very high, but it can, of course, be indefinitely increased by increasing the number of boxes.

A New Photo-Electric Element — Dr. Emile Bose, of Breslau, has discovered an electro-optical phenomenon which, besides its theoretical interest from the point of view of the relations which are gradually becoming more narrow between optics and electricity, may be able to receive a number of applications. The following description of his work was taken from the *L'Industrie Electrique:* If in a lightly acidulated solution a current is passed for a long time between gold electrodes the appearance of the anode is considerably changed and it is found to be covered with a layer of hydroxide. If the charging current is stopped and the electrodes are connected to a galvanometer of high resistance the light will be found to be traversed by a current of which the intensity is a function of the illumination of the electrode covered by hydroxide. Differences of potential obtained from different luminous sources amount to as much as one-tenth volt and depend both upon the color and the intensity of the light. Intense lights lower the potential of this element. The violet obtained by decomposing the light of an electric arc by a prism acts similarly to white light. Sodium light and the yellow and green parts of the spectrum do not exercise a sensible effect. Red light, such as is obtained from a lithium flame, augments the electro-motive force of the element to a value higher than it develops in the dark. X-rays have a powerful action similar to that of white light. These widely different actions of red and violet radiations constitute one of the rare cases in which the different parts of the spectrum act qualitively in different fashions. In almost all other optical phenomena the effects of red and violet rays are qualitative in the same sense and differ only in quantity. If, by later studies, as appears possible, effects proportional to the cause may be obtained, the new phenomenon may be immediately utilized in the construction of a direct-reading photometer.

Magnetic Properties of New Irons—Herren E. Gumlich and E. Schmidt, of the Reichsanstalt, have published an article on this subject in the *Elektrotechnische Zeitschrift,* which has been abstracted in the British *Electrician*. They have collected a large amount of valuable material in regard to the various new types of iron and steel lately introduced, such as Kohlswa iron, Remscheid dynamo steel, Gelsenkirchen cast steel and Böhler and Remscheid tungsten steel. The last shows the greatest hysteresis, and the greatest permeability is shown by Kohlswa iron No. 52, annealed five times over. The figures are 3,680 for the permeability of the latter and 3,240 for the permeability of Remscheid dynamo steel. Measurements extending over some forty-six specimens bring out a clear relation between hysteresis, resistance and the other magnetic properties. The rule holds good, with few exceptions, that a high hysteresis loss means a high electric resistance, a greater remanent magnetism, a greater coercive force and a lesser maximum permeability. The authors mention a new material of secret composition which forms a striking exception. It has a higher resistance than hardened steel, shows an extraordinary remanence and maximum permeability, and at the same time a small coercive force and hysteresis loss. This specimen, labeled No. 15, guarantees a small loss both from hysteresis and from eddy currents in dynamos.

Reduction of Nitro-Urea—At the last meeting of the Chemical Society, Mr. Holroyd contributed a paper on the electrolytic reduction of nitro-urea, in which he employed an alternating current, and succeeded in bringing about the decomposition of this compound. His paper has been digested in *Lightning*. He used the make-and-break contact for producing the alternations, suggested by Mr. Vernon Harcourt, based upon the oscillations in a column of mercury attached to a large flask containing air and heated. By this arrangement the oscillations in two tubes of mercury can be maintained for a long time, and so give an alternating current from a direct one in the laboratory without any special alternator. In this connection it will be interesting to note that Herr B. Suler has shown that in the electrolytic reduction of nitrates the stronger the solution the greater the amount of ammonia, while in weak solutions the amount of hydroxylamine is greater than that of the ammonia. As the current density increases, the yield of both these products diminishes, and with increase of temperature the amount of hydroxylamine produced rapidly falls away, until at eighty degrees centigrade only a few per cent is produced. Signor Chilesotti points out that good yields of amines are obtained when small quantities of tin or copper salts are added to the electrolyte. The first reaction apparently is the production of the hydroxylamine from the nitro compound, and the reduction of the metallic salt to the lower state of oxidation. These later reduce the hydroxylamine to the corresponding amine. Herr J. Moller has obtained seventy per cent of the theoretical yield of ortho-amino-anthraquinone from the corresponding nitro compound by electrolyzing the alcoholic solution either in presence of sulphuric acid or in a slightly alkaline solution containing sodium acetate. His best result was obtained with an electro-motive force of three to three and five-tenths volts and a current of one ampere per sq. dcm. With a higher current density, as shown by Herr Suler, there is a loss.

Photometry of the Ultra-Violet Rays—The great intensity of the light electric effects produced by an electric spark leads Herr H. Kreusler to experiment with a view to determining whether the phenomenon might not lead to a method in photometry. An account of his work has been published in the *Annalen der Physik* and abstracted in the *American Journal of Science*. The electrodes for the spark consisted of aluminum zinc and an alloy of equal parts of zinc and cadmium, with addition of five per cent of antimony. No constant light was obtained except in the case of aluminum if both electrodes were of the same metal. This constancy was obtained, however, if the negative pole was made of aluminum. The photoelectric cell was that of Warbury, consisting of suitable electrodes in an atmosphere of rarefied hydrogen. The measurements were carried out with the object of determining the absorption coefficients of various gases and of water. Although there were evidences of constant errors the method seems a promising one.

Electric Power in Belgian Coal Mines.

Mr. George W. Roosevelt, United States Consul at Brussels, gives the following facts regarding the employment of electricity in Belgian coal mines: One of the most important coal mines in the Charleroi district has concluded arrangements for the erection of a central station, which will supply electric motor power for three mines now in operation, situated several kilometres distant from each other.

The pumps are placed at the bottom of the pits at a depth of 500 metres (1,640 feet). The station furnishing the power is on the surface and is composed of powerful steam engines of modern construction turning large electric dynamos. The electric current which feeds them all is produced in the generating station and is transmitted over a considerable distance by means of three small wires only a few millimetres in circumference, mounted on poles, then conducted into the pits by a cable sheathed in steel. This method replaces that of the direct traction pump with shaft weighing thousands of kilogrammes and exacting a special exhaustion well, and only giving five or six piston strokes per minute. The electric pumps give from 150 to 200 and even more strokes per minute, and occupy very little space in the gallery.

Electric pumps offer the advantages of requiring less expenditures in placing them, less trouble to keep in order, and of being safer and much more economical as regards consumption of steam. Another advantage is that they do not conduct steam into the pits, a source of great vexation on account of resulting leaks, condensation of water, deterioration of work, great heat, etc. It is also claimed that the electric power may be employed in operating the windlasses of the mines, machines employed in washing and sorting, small cars, and for illuminating purposes. The centralization of motor force in coal mining—that is to say, the suppression of numerous small boilers and steam engines—will result in great saving in fuel.

The installation herein mentioned will comprise in all four electric pumps of 200 horse-power and two groups of generators, giving 1,200 horse-power. The work has been confided to an important electric company at Liege, Belgium.

The building which is used for physics and chemistry at the University of Michigan is being remodeled. The changes are now well on the way toward completion.

Rubber Culture in Nicaragua.

United States Consul William B. Sorsby reports that judging from the experience of several people who have attempted rubber culture in that immediate vicinity, there would seem to be a reasonable doubt of universal success, notwithstanding the fact that the experiments were confined to localities where the wild rubber trees had been most abundant, both in number of trees and yield of rubber. In two notable instances, after the plants had obtained from four to six years' growth, the planters became discouraged with the outlook, and, cutting down the young rubber trees, planted cocoa.

There is one rubber plantation remaining in that locality in which the trees are about eight years old, but the little bleeding attempted thus far has been unsatisfactory.

Taking the consensus of opinion of those indigenous to the soil, who have had an opportunity to observe the progress of a planted tree—planted occasionally by some one as a novelty—he would say while there is no apparent reason why india-rubber culture in certain localities of Central and South America should not be successful, it is well for those of limited resources who may have invested in rubber plantations to be prepared for disappointment, if they rely upon getting substantial returns from rubber trees of less than twelve or fifteen years' growth.

Large Railway Profits.

It is said that more than 36,000,000 passengers were carried on the lines controlled by the International Traction Company, of Buffalo, N. Y., for the quarter ending September 30, 1901, if the figures shown by the gross receipts represent five-cent fares only. The report is as follows for the corresponding quarter in 1900 and 1901:

	1901.	1900.
Gross receipts.....	$1,802,277.23	$761,197.29
Operating expenses.	$760,697.43	$348,745.49
Net earnings from operating	1,041,579.80	412,451.80
Miscellaneous earnings	74,275.21	30,273.40
Total earnings.....	$1,115,855.01	$442,725.20
Fixed charges.....	307,206.07	241,792.86
Surplus	$808,648.94	$200,932.34

The Milwaukee Electric Light and Power Company is preparing to construct a tunnel under the Milwaukee River, in Milwaukee, Wis., from East Water street to Reed street. This tunnel is to be made five feet in diameter. It will be used for the company's underground wires. The police and fire-alarm wires of the city are also permitted to make use of the tunnel. The tunnel will be placed about fifty feet below the surface of the river.

Russian Trade in Manganese.

The shipments of manganese in Russia have never been as large as they were in 1900, when 426,179 long tons were sent abroad, since the inauguration of the manganese industry in the Caucasus. This growth was due partly to the heavy demand from Europe and also to the reduction at the beginning of 1899 by the Russian Government of the rail freight rate from Tchiaturi to the main line of the Trans-Caucasian Railroad at Sharopan from 10 cents to 7 cents per pood of 36 pounds avoirdupois. Some impetus was also given the industry by the higher market value of the ore, which has enabled many of the smaller properties to continue active operations. It is understood that the shipments to foreign countries from the ports of Batum and Poti from 1885 to 1900, inclusive, amounted to the large total of 2,514,121 long tons. Of this total the United Kingdom received the greater part—994,848 tons, or 30 per cent—the next largest importers being Holland, France, United States and Belgium. The ore imported into Germany is shipped through Holland. The leading manganese-producing centres are Mgrimevi, Shukruti, Zeda-Rgani and Pervessi. Of late, producers have not been so careful in selecting ore for export. In a number of cases they ship the ore as it comes from the mines without sorting, and often mix the new product with waste that has been lying on the ground for years. There has been some complaint in this regard, but as Russia is the principal source of supply, furnishing nearly 50 per cent of the world's exports, consumers make the best of the situation. Of course, when contracts call for a certain grade of ore the Russian exporters are more careful.

St. Louis Elevated Railway.

An old plan for an elevated railway in St. Louis has been revived. A franchise was granted to the Rapid Transit Company of Missouri in 1889. Recently it has been discovered that this franchise is available at the present time. It was granted for a period of fifty years. In 1887 a company was organized with an authorized capital of $7,000,000. Among those interested in the company at that time were Mr. Thomas A. Scott, a New York banker; Mr. Samuel F. Scott, postmaster of Kansas City, Mo., and Mr. Alfred C. Carr, of St. Louis. It is said that the directors of the old company will shortly hold a meeting for the purpose of discussing plans for interesting the capital required for the enterprise.

The Electrical Operation of Modern Machine Tools and Machinery.*

By Robert T. Lozier.

PERHAPS the most interesting feature of this subject is in comparing electrical operation of tools and machinery, either by a general subdivision of the power or individual application, with the old method of transmitting the power from the main engine entirely by belts and shafting. There was a time when the salesman of electrical apparatus wasted his sweetness upon the almost desert air in endeavoring to convince operators of industrial establishments that the electrical system was better from almost every standpoint. But now the few new shops that are driven entirely by belt transmission are in the minority and generally operate under conditions of such peculiar nature as to make the belt and shaft system particularly desirable. In fact this subject has been threshed out to such an extent that we all now recognize the superiority of electric transmission over the entire belt and shafting system, and the futility of considering the use of the latter suggests the situation disclosed by the lawyer who stated to the court that there were three good reasons why his witness was unable to appear: "The first is that the witness is dead;" whereupon the judge exclaimed, "Then the other reasons are unnecessary."

However well satisfied we may be of the fact that entire belting transmission is dead, and you notice that I differentiate between entire belting and belting with motors, perhaps it may not be amiss to hold a post-mortem on the subject.

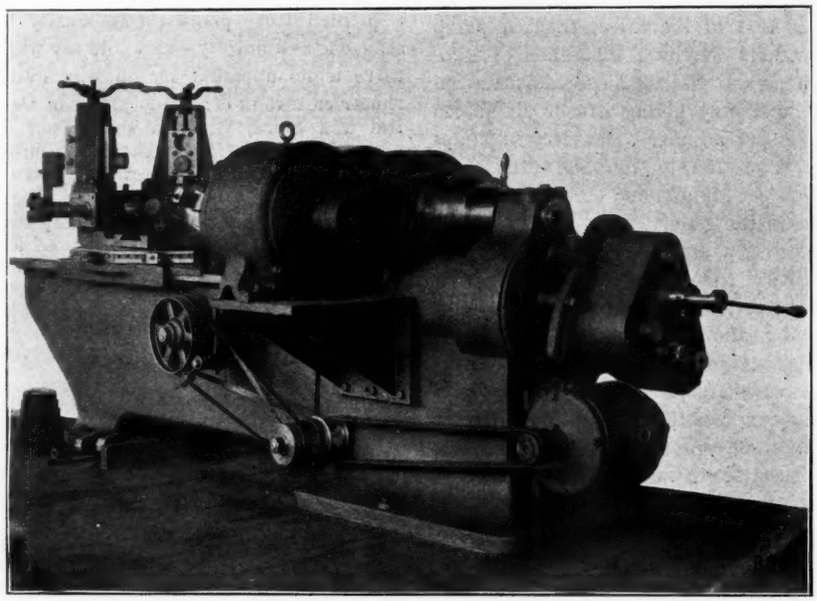
If we examine its heart, which is represented by the main engine, we find it has valvular trouble and can not force, throughout the system, the circulating medium that gives the body its energy. The arteries are clogged, and a greater pressure is required to overcome the reduction in their calibre. We also find the lungs—the breathing spaces in the shop—filled with extraneous matter such as dust, dirt and oil drippings, and the other organs are so impaired that they can not perform their respective functions efficiently, enabling the body to work to the very best advantage.

A diagnosis of this case was made, not as long ago as you might have expected, by Alfred H. Gibbings, electrical engineer of the city of Bradford, England, in 1898 and 1899, but he found the following obstacles to the general application of electricity by what he terms "the commonality of the manufacturing world:"

(1) Extreme aversion to innovation which characterizes the electrical world in Great Britain especially.

(2) The existence of other motors in good working condition.

(3) The unsuitability of alternating currents of electricity for motors when the power required exceeds two or three horse-power.



Bullock Motors Operating Turret Lathe.

(4) The want of capital to lay out the new machines.

(5) The want of confidence in the electric motor of the non-technical manufacturer.

We will endeavor to discuss, in a general way, the obstacles which Mr. Gibbings brings attention to, although I think we will grant that in this country these obstacles were met and overcome several years before the date of Mr. Gibbings's article. Yet they are of interest, as they point out just what troubles had to be overcome, both here and abroad, and I hope to-night to show by demonstration and illustration what has been accomplished in a practical manner in overcoming the disadvantages of the entire belting system, and removing the objectionable features of the individual motor.

Let us take these two subjects up in the manner in which I have just presented them.

If we turn to Professor Benjamin's exhaustive paper on losses in machine shops, read before the American Society of Mechanical Engineers in December, 1896, we will find that by a series of very thorough tests he determines the losses attributable to the number of pulleys and belts involved, the degree of tension and consequent friction of the belts, as to whether or not the shafting was in line, results of different methods of lubrication, and gives the following accumulated data gathered from sixteen establishments that he investigated the losses of.

This data show that the average loss involved in the transmission of power represents from fifty-five to sixty-five per cent of the total power generated; say it is fifty per cent of the total power, then it will represent 100 per cent of the effective or useful power. If we have a plant of 100 horse-power, and it requires fifty horse-power to operate the tools and fifty horse-power to get the power to the tools, that means we

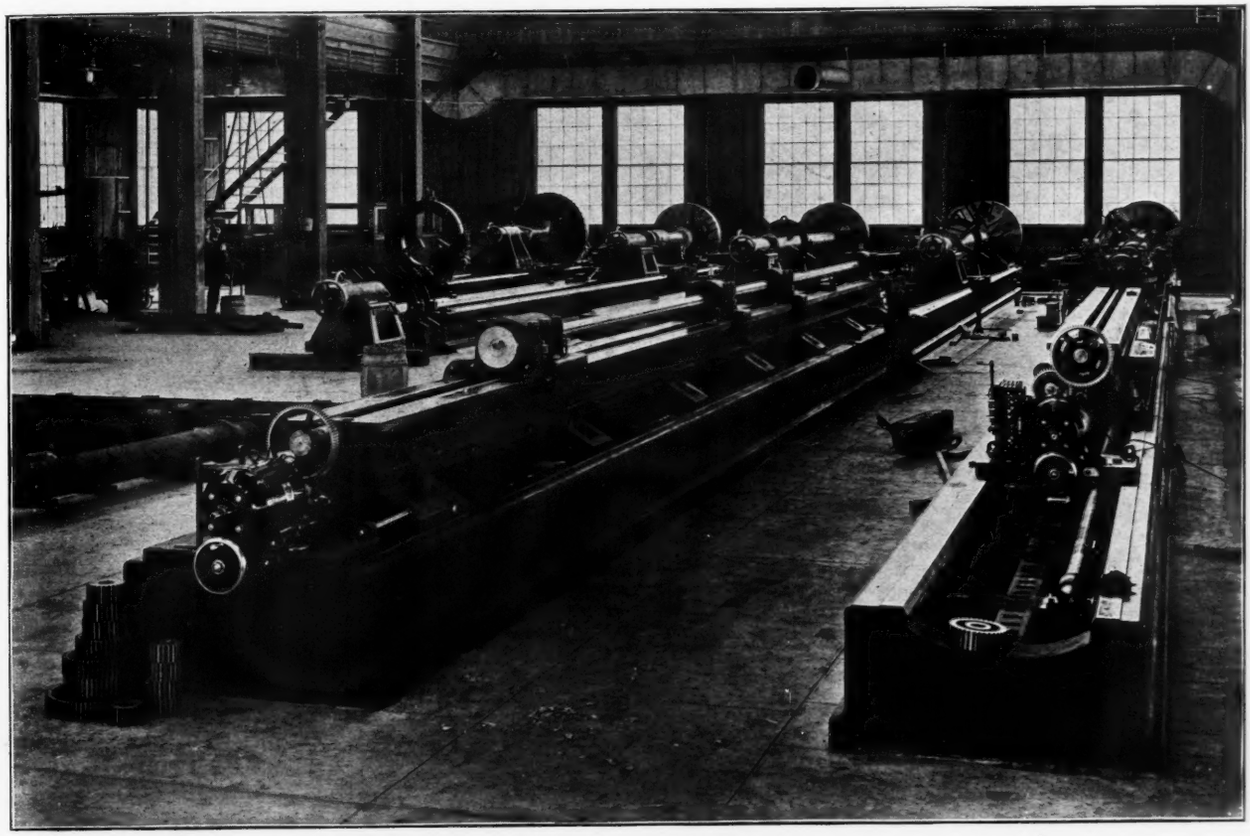
* A paper read before the New York Electrical Society, November 26, 1901.

are losing 100 per cent of the effective or useful power. And we must not forget that this loss is fixed and is not reduced as the load diminishes, so that if the useful power drops to twenty-five horse-power,

Friction of engine.....	10 H. P.	or 10 per cent.
To drive shafting.....	15 "	" 15 "
Belts and pulleys.....	15 "	" 15 "
Empty machines.....	15 "	" 15 "
Cutting material.	45 "	" 45 "
	100 H. P.	

Motor and shaft.....	12 H. P.	or 30 per cent.
Machines.....	28 "	" 70 "
	40 H. P.	

We note from the foregoing that the driving and transmitting force is but for-



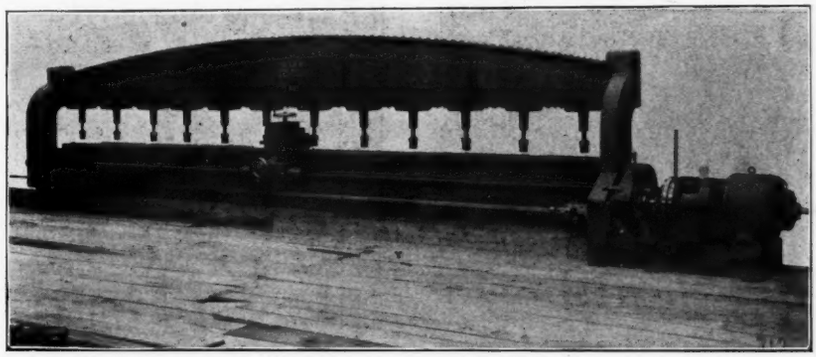
METHOD OF OPERATING TAIL STOCKS OF LATHES BY A MOTOR.

then this waste power becomes 200 per cent of the effective.

Professor Benjamin, who has been following this matter closely since his paper of 1896, in January, 1901, analyzed the distribution of power in the shop. He says: "Stating the case roughly for the ordinary machine shop, every 100 indicated horse-power of the engine may be distributed thus:

"Even this efficiency would probably be realized only when all the machines were working at their full capacity."

In this case he found the average loss of getting the power to the tool to be fifty-five per cent of the total, or 122 per cent of the effective, while in the test on the group system, operated by motors, taken on the basis of 100 feet of line shafts, he found:



MOTOR (THREE HORSE-POWER) DIRECT-CONNECTED TO A PLATE BENDER.

ty-three per cent of the effective, instead of 122 per cent in the case of all-belt driven.

Professor Benjamin does not state if he has included in the motor-unit its proportionate share of line loss, five per cent, and generator loss, eight per cent. But these latter are more than offset by the circumstance of the tools being shut down and then all loss is stopped.

Our good friend and past president, Mr. Gano S. Dunn, in a paper presented before the American Institute of Electrical Engineers, on April 26, 1889, put the problem as to whether we should have 100 feet of shafting driven by one motor, or three groups of thirty-three and one-third feet each driven by three smaller motors. "Taking a duty of one horse-power upon the shaft for every five feet of length, corresponding to like machine-shop practice, and taking a coefficient of friction of five per cent, and a speed of 200 revolutions, transmitting 200 horse-power with the belts pulling horizontally in opposite

directions, we find the per cent of saving in using three small motors instead of one is two per cent."

This is getting the question of economy down pretty fine. In this statement Mr. Dunn puts in the hands of the engineer means of determining how far the question of subdivision of the prime movers can be carried purely from the standpoint of efficiency.

Of course, if a separate motor is applied to each tool, the loss in transmission becomes almost negligible, in spite of the theoretical losses that are sometimes attributed to the slow-speed motors that may be used in that system. The large establishments in which the individual motor is freely applied find that the average load of the generating plant is but one-sixth, or sixteen and two-thirds per cent of the total connected load, including the electric lighting cranes and trams; that is to say, if we have a plant the motors and lights of which aggregate 1,000 horse-power, it is not unreasonable to expect that the demand upon the generating plant will run about 166 horse-power, and that this demand will not exceed the maximum of 250 horse-power for a considerable length of time, so it will be seen that a plant with such a large connected load can turn out its considerable product with a remarkably small expenditure of power.

Now, what does this question of economy in power represent in dollars and cents to the producer?

Professor Charles E. Emery, in his paper of March 23, 1893, before the American Institute of Electrical Engineers, tells us that the costs of producing a mechanical horse-power are as follows:

With coal at $3 per ton for simple, high-speed, non-condensing engines, for ten hours a day for one year (about 500 horse-power generated), $36.17 per horse-power. With special low-speed, triple-compound engines, $24.19 per horse-power.

From these costs it is not difficult to determine what ratio the cost of power bears to the product of the shop which it drives. From empirical data I am able to state that the average ratios run pretty close to the following:

COMPLETE BELTING TRANSMISSION.

With the cost of steam power at $36.17.. 2% of product.
" " " " 24 19.. 1.3% "

SUBDIVIDED MOTORS.

With cost of steam power at $37.17... ... 1% of product.
" " " " 24.19..... .8% "

INDIVIDUAL MOTOR DRIVES.

Here the amount of power involved is so small as to increase the cost per unit, but I have known it to be less than..... .4% of product.

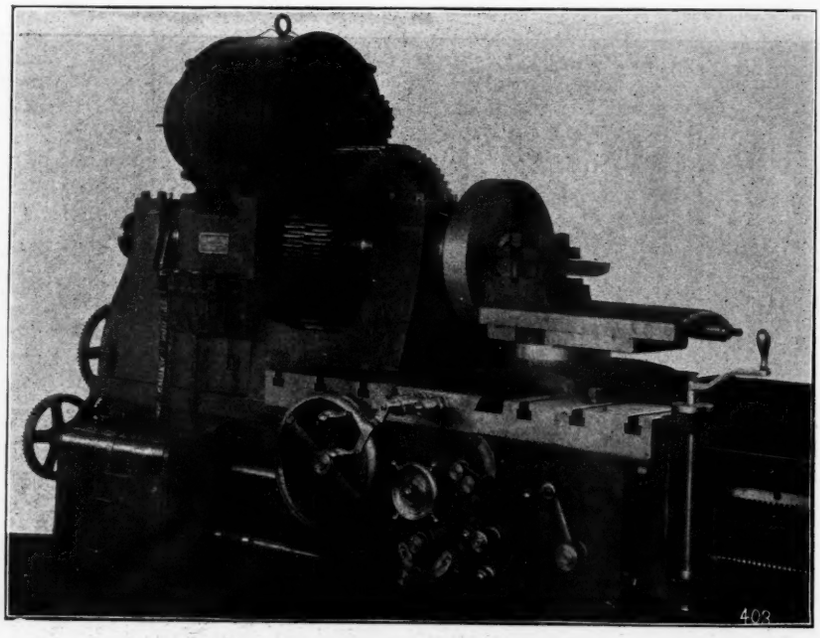
Assume a locomotive shop, a large cloth-printing concern or any other establishment in which a large amount of power is used in running its machinery to produce an output which we say amounts to $1,000,000 a year; and if we assumed that it uses the very best methods of producing its power we find that the cost of that power per year, with the different methods above outlined, would be as follows:

METHOD OF DRIVE.	COST OF POWER.	YEARLY SAVING.
All belts and shafting....	$17,000	.....
Subdivided motors.....	8,500	$8,500
Individual motors.....	4,000	13,000

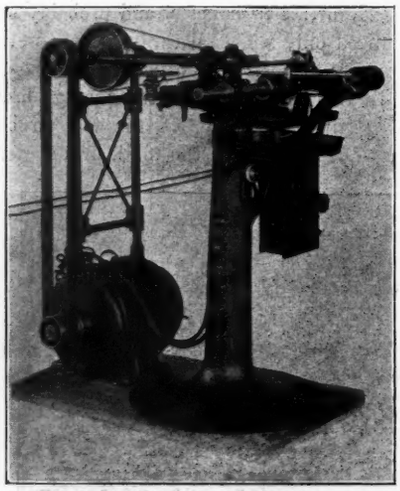
So that a subdivided motor system saves enough over the old method of belt and shafting to pay ten per cent yearly on a plant that would cost $85,000, and the individual motor application could support, at that rate, a $130,000 plant. Of course, the latter need not be entirely composed of individual motors, but groups of small machines can be driven by one motor whenever the equation favors that method.

From the foregoing figures we can tell, with reasonable closeness, what this subject of economy in power transmission means, and how far it will go toward representing the interest and depreciation upon the plant that it is necessary to purchase, in order to accomplish such savings. The figures given are stated with the view of applying them to a broad view of the subject; they are gathered from actual plants now in operation and may be taken to fairly represent general conditions. So much for the question of mere economy.

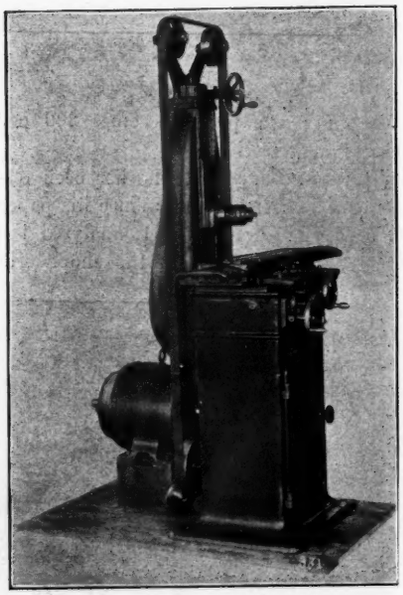
Professor Benjamin says, in concluding one of his able articles, that "This is the



MOTOR GEARED TO HEAD STOCK OF LATHE.



AN ELECTRIC MOTOR BELTED TO A GRINDER.



MOTOR DRIVING SURFACING MACHINE.

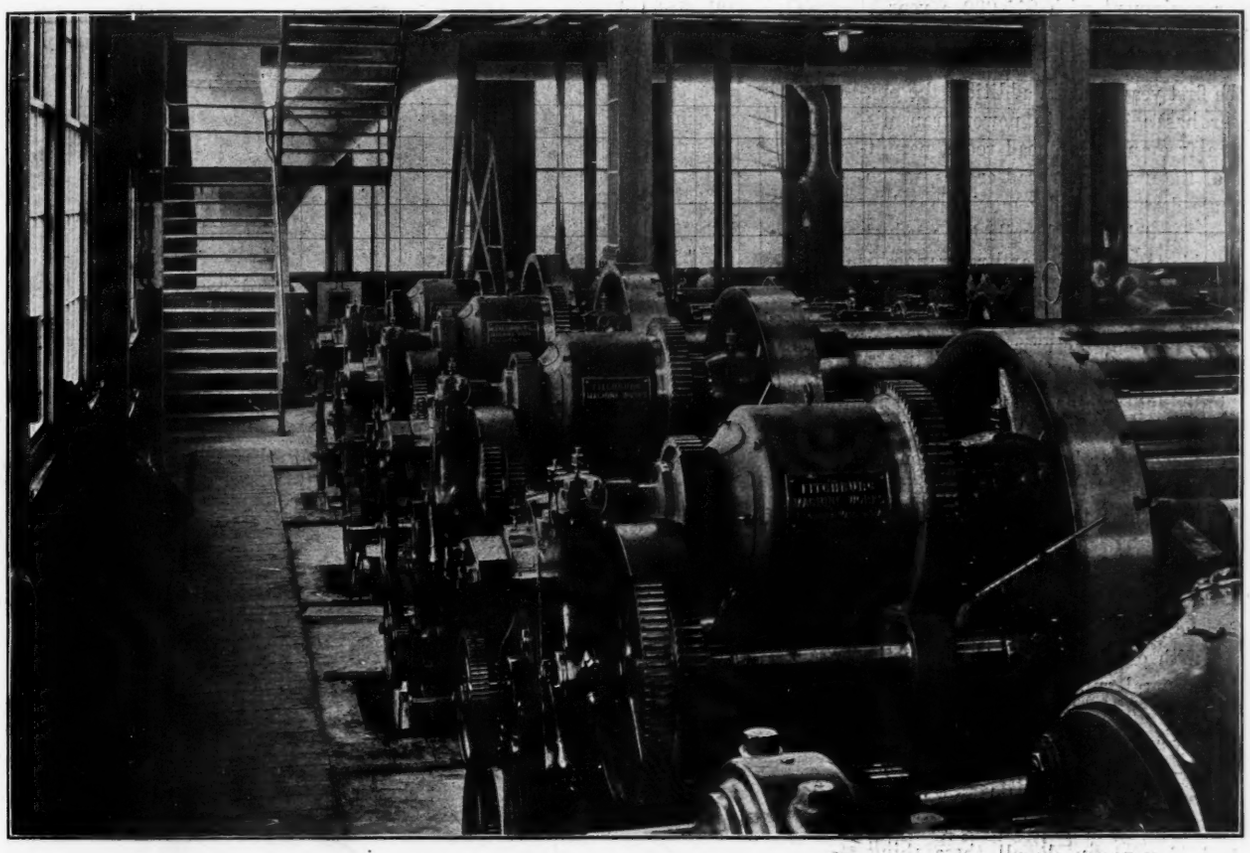
era of small economies in factories," but he suggests a broader and more important consideration of this subject of power distribution by saying:

"No doubt it is time that to-day the question of time is more important than that of power, and that in the endeavor to get the most product per machine, and per man, the minor subject of coal and water consumption has been overlooked."

In my article in *Cassier's Magazine*, December, 1896, I bore with particular emphasis on the importance of getting the most out of a given shop equipment with a given payroll. It was not then, and I doubt if now this is an era in which as much attention is being devoted to the smaller economies as it is to *speed* in operation.

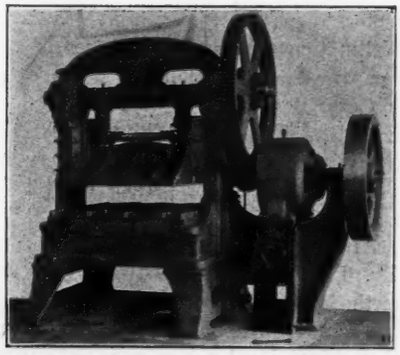
In every line in the civilized world they are endeavoring to increase the sphere of action by increasing the quickness of operation. We use the telephone because it is quicker, trolleys because they are quicker, automobiles because they are quicker, and one of the greatest factors in determining the speed of the trolley and the automobile is the quickness of their control.

The question comes down to us in every operation, what is the quickest method we can apply, not what is the cheapest in first cost, nor in which the smaller economies are apparent. See how the stenographer has increased the output of every commercial and industrial establishment, and what I have to say to-night about the quickness with which we can operate the individually driven tool bears a direct analogy.



Lathes Driven by Motors.

Let us, therefore, leave the question of what we are going to save in power transmission and other considerations of relatively minor importance, and go at once to those matters of increased output and entire flexibility in the arrangement of the shop equipment.



Blanking Press Geared to an Electric Motor.

It is true that the individual motor, properly controlled, can increase the product of an establishment. I have it on good authority from several sources where such equipments are used that the outputs have been increased from eight to twenty-five per cent with the same equipment and payroll, due directly to the use of these motors, which many times are used in conjunction with a group-drive system. I know that the Cocheco Mills, at Dover, N. H., one of the first to apply these principles, increased the output of their presses on certain classes of high-speed printing to as high as eighty per cent. Not only was this accomplished by having increased facilities for varying their speed, but a much greater range was available, and they found that they could operate successfully at much higher rates than the old fixed mechanical ratios confined them to. I could quote a great many cases to illustrate this important feature of my evening's paper, but I am anxious to bring these matters within definite conclusions.

If it is true that with increased speed facilities we can increase the output, and we limit that output in the case of the individual motor to, say, ten per cent, and that is low enough to cover the increase in most any kind of a well arranged plant, then let us consider the case that we took as a basis to determine the relative cost of transmitting the power

—an establishment producing a $1,000,000 product yearly. If we can increase this product by ten per cent, we have $100,000 more with the same shop equipment and the same expenditure for fixed charges and payroll. Allow for raw material, say, $25,000, and we can credit the motor equipment with $75,000 a year.

This will probably more than pay for the entire equipment of individual motors in the first year, and, in addition, the purchaser has a saving in power transmission, a free and clear head room, permitting of the use of overhead cranes, which, in these days of rapidly moving machinery, we must have to handle the product. He is able to reorganize and rearrange his shop at any time, to remove old tools and make room for new.

Now the manufacturer says, "If it is true that all these things are possible to the individual motor drive, what stands in the way of the general adoption?" and he calls in his mechanical superintendent and his electrical engineer, and they boil the matter down to a few concrete questions.

Can you build a small motor so that it will stand hard usage?

Can you take that small motor and apply it with good mechanical construction to the general run of tools and machinery?

After you have got it applied, will it do its work—has it the torque—has it the force to turn off the metal and put the tool to its work and hold it there?

And if you can do all these things, can you vary its speed?

Can you get constant speed below the maximum, and hold it with a varying torque?

Can you successfully get the various speeds that our particular class of work demands?

And the manufacturer says, "I'll pay the higher price for the equipment because it seems that that pays for itself within one year, and makes money besides."

Now, my answer to all this is, that not only can we do so, but we have been and are doing so. I propose to show you practical demonstrations of the success of the individual motor in fulfilling all of the demands put upon it, some of which have been most abnormal; one of which is the works of the Fore River Ship and Engine Company, Quincy, Mass.

To this end I have a number of photographs of establishments in which electricity is applied to tools and machinery, in accordance with the latest methods. One of these is the Fore River Ship and Engine Company, of Quincy, Mass., a large establishment equipped in accordance with the very best and latest engineering practices, and one in which the individual motor drive is giving a practical demonstration of its complete success.

This plant has a connected load, consisting of motors, arc and incandescent lighting, of nearly 3,000 horse-power, and its average load is about 260 horse-power. This latter item may be increased as more work is put upon the tool. The load at present is distributed among 112 motors, half of which are of five horse-power or under. To get an idea of the service put upon an individual motor, I have here to-night some data on some very heavy turning work, and have samples of the chips. The tool was a sixty-inch lathe, running with all back gears in head of lathe; the motor was of six and one-half horse-power capacity, operating at full line voltage. Results were as follows:

Machining twenty-inch steel shaft thirty-two feet long, weighing nearly twenty-four tons.

Taking two chips, one tool following the other.

Feed was three-eighths inch.

Cutting speed, eighteen feet per minute.

Line voltage, 235.

Amperes no load (turning steel shaft only)—twelve by four horse-power; sixty-six per cent of motor load.

Amperes with load average forty-five—fifteen horse-power, 250 per cent of motor load.

Amperes with load maximum eighty—twenty-six horse-power, 433 per cent of motor load.

Due to the excessive overloads it was necessary to change one set of brushes. It was, however, an emergency job, the motor was kept at its work, Mr. F. O. Wellington, the general manager of the company, stating that it was the quickest job ever done with so large a piece of material. The motor did not heat excessively, although it stood at over 300 per cent overload for periods of at least half a minute.

After showing a number of illustrations Mr. Lozier went exhaustively into the methods of speed control that were available, and closed his remarks by stating that if individual motors were to be used, it was of prime importance to have them large enough; a margin of at least twenty-five per cent over what was supposed to be a generous estimate, was necessary to the success of the equipment, and quoted several well-known shop superintendents on the subject.

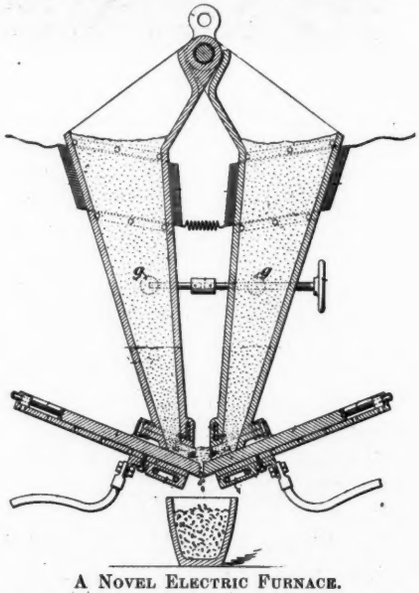
Electrical Patents

In order to obviate the tedious and laborious operation of testing the individual wires of a telephone or similar cable, Mr. John D. Peachy, of Newark, N. J., proposes to provide in the cable enlarged spliced tubes which are hermetically sealed to prevent the introduction of moisture or dampness to the interior.

IMPROVED CABLE SPLICE.

Within the enlarged tube, the ends of the meeting wires are joined and the connections are each covered by an insulating sleeve to prevent short-circuiting. Upon these sleeves are placed identifying marks which may be numbers, letters, or the like, and which correspond to similar marks placed upon the individual wires at the central office. By this arrangement, when it becomes necessary for the workman to open the splice, he will be enabled easily to make the selection of the individual wire without the necessity of testing a large number of the same.

Another novel idea in the line of electric furnaces has been hit upon, this time by Mr. Marcus Ruthenburg, a resident of Philadelphia, Pa. The broad feature of the invention resides in the construction

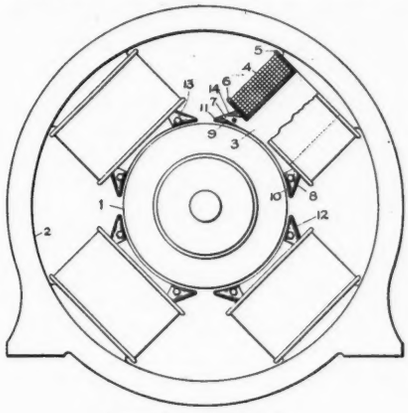


A NOVEL ELECTRIC FURNACE.

of hollow electrodes, which constitute magazines or hoppers through which the material to be fused is passed. In his preferred form, the electrodes are pivoted together, but insulated from each other at their upper ends, while their lower ends can be swung toward and from each other,

the distance being regulated by an insulated adjusting screw that connects the two. In view of the fact that the arc is formed at the lower ends it will be evident that in time they will burn out, and the inventor therefore provides removable shoes which can be replaced without the necessity of an entirely new machine. A further feature of the invention resides in making the electrodes of magnetizable material and providing coils upon the same so that the material to be fused is first magnetized.

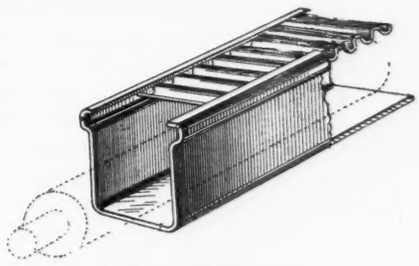
Mr. Alexander D. Lunt, of Schenectady, N. Y., has just patented an "anti-hunting" device, which he has assigned to the General Electric Company. The invention relates to a means for preventing hunting of synchronous alternating-current machines—such, for example, as alternating-current generators, rotary converters, or the like. Specifically considered, the invention comprises short-cir-



Anti-Hunting Device.

cuited conductors placed about the pole-tips of the machine to which the device is applied. These short-circuits, since they embrace only the pole-tips of the machine, are consequently very compact in structure and being of minimum length or extent are therefore of minimum resistance, thereby giving rise to correspondingly powerful currents which oppose any hunting tendency which may exist. The details of the invention, as well as its mode of application, will be better understood by reference to the accompanying drawing which represents a synchronous alternating-current machine having an armature indicated merely by the circle 1, and a field-magnet structure or frame 2. In the particular case shown the machine is provided with four poles similarly constructed, the structure of one of which is shown in detail at 3. This latter pole-piece is shown partly in section and partly in side elevation. The field winding is indicated at 4 and is held in place between the heads 5 and 6 of the field spool. The pole-piece itself is provided with tips 7 and 8, extending oppositely from the pole and located in close relation to the surface of the armature 1. The ends of the tips 7 and 8 are, however, slightly chamfered off, as indicated at 9 and 10, respectively. An oblong mass of metal having an elongated opening therein is slipped over each pole-tip. These masses of metal form the seats of induced currents, the reaction of which opposes any hunting tendency of the machine. The form of cross-section of these anti-hunting devices is represented at 11 and 14, the lower limb of the device being wedge-shaped, so as to fit under the chamfer 9 of the pole-tip 7 and lie in as close proximity as possible to the surface of the armature 1. The lower limb is somewhat extended along the surface of the armature, so as to form a projecting tip, as shown. The lower and upper limbs of the sections of the device are connected by integral end connections indicated in the drawings at 12. To secure the anti-hunting device in place any suitable mechanical device may be employed—such, for example, as set screws 13 engaging slight depressions in the surface of the pole-tip. In operation powerful currents are set up in the short-circuits described, the path of the currents being, as will readily be seen, along the lower limb or limbs 11, through the end connections, and then across the top limb or limbs 14. The currents thus set up act powerfully to oppose irregular motions of the armature to which the existence of these currents is due. Owing to the exceedingly compact nature of the short-circuit devices the currents induced therein are exceedingly powerful and act effectively to prevent hunting without at the same time giving rise to an undue expenditure or waste of energy.

A new metallic conduit for electric wires has been patented by Mr. Emmet D. Page, of Brooklyn, N. Y., the present invention being an improvement on a former patented construction. The conduit proper is made in trough form, preferably of sheet metal bent to the desired shape and having the upper edges of its side walls provided with opposed longitudinally extending grooves adapted to receive a sliding cover. These grooves are formed by bending the metal into suitable shape, so that the outer webs or edges will overlie the edges of the cover. This cover is made of comparatively thin metal and is grooved or corrugated transversely. By having the cover corrugated it can be bent outwardly or in a direction substantially perpendicular to its length, so as to be readily withdrawn from the grooves in the conduit or can be straightened out as it is pushed into said grooves, while at the same time the transverse corrugations tend to stiffen the cover, so that it will resist pressure and blows. By preference the outer webs of the grooves will be made pliable, whereby they can be bent outwardly to enable a portion of the cover



Metallic Conduit.

to be inserted at or removed from any desired part of the conduit, and as the cover can be readily bent it will be apparent that it can be connected with or disconnected from the grooves at such points by sliding it into and from the grooves. The grooves of the conduit hold the cover firmly upon the same, with the advantage of the cover being straightened, while at the same time being permitted to be readily bent when being applied or detached. The conduit and the cover when made of metal can be used as a grounded circuit, and one or more electric wires can be placed in the conduit, according to the dimensions.

The officers of the Chicago & Northwestern Railway are said to be considering a plan for telephoning from trains to different parts of Chicago while the trains are standing at the station. It is the idea to equip the Overland Limited train of this railway with telephones and connect them with wires of the Chicago Telephone Company for the convenience of travelers who may desire to telephone to friends or for business purposes after they have reached the depot before the train has started. It is further planned to equip the cars with telephones to be used between the different parts of the train while the latter is running. This was done recently by the Canadian Pacific road on the special train used for the travels of the Duke of Connaught. The plan is to place small telephones in every compartment and in one end of the open sleepers. In this way if a patron desires something from the dining-car, a luncheon, a meal served in the sleeper, etc., all that will be necessary will be to ring up the porter in the dining-car, conductor of the dining-car or the news agent and order what is wanted. This will obviate the necessity of calling a porter and waiting his pleasure.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—XVIII.

BY A. E. DOBBS.

TOLL LINES AND THEIR TRANSPOSITIONS.

In the last chapter reference was made to transposing country and toll lines, but nothing was said about the transpositions themselves.

The necessity for transposition—or crossing over of the circuits—arises from the fact that any wire carrying an alternating current is influenced by another wire in the immediate vicinity, and, in

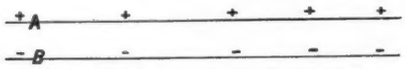


FIG. 77.—ELECTROSTATIC INDUCTION.

turn, impresses a current on the other wire, the impressed current impulses being in a direction the reverse of the impressing current impulses.

Thus, in Fig. 77, we will suppose a + current to be sent into the line A. By connecting a voltmeter to the wire B we find that when the impulse in A is +, or positive, the impulse set up in the wire B is —, or negative, and *vice versa*.

Moreover, this impulse in the B wire is only an instant in duration, and if the current in A continues in the same direction no further current in B will be observed, but when the current is broken or reversed there will be another movement of the voltmeter.

Now the amount of current induced from the line A to the line B depends upon four things:

1. The distance they run parallel to each other.
2. The distance between the conductors.
3. The size of the conductors or the amount of surface exposed.
4. On the insulation of the lines.

These propositions can all be proved in a very simple way, for the action of the wires under these conditions is precisely that of the plates of a condenser, which depends for its capacity upon the thickness and nature of the dielectric and the surface exposed.

To prove the first of the above propositions take a length of switchboard duplex or "twin" wire of 1,000 feet. Connect a telephone receiver in circuit with the two ends of one wire—or connect one end to earth and leave the other end open, if you prefer—connecting a battery to the other wire with a contact that can be readily made and broken. Having tried this with 1,000 feet and taken note of the loudness of the click, try it with 2,000 feet and then with 500 feet and note the difference, and if both wires should complete the return through the earth it will be found that with 3,000 or 4,000 feet of wire in circuit a conversation can be carried on from one line to the other.

Second Proposition—This is proved by the fact that with grounded conductors one mile of single-wire cable (cable in which the conductors are not twisted in pairs) will have as much cross-talk as from five to eight miles of overhead aerial lines, even though the insulation of both cable and overhead wires should be equal. Take a sheet of lead out of a tea-chest and it is easy to get a piece of lead about three feet square. Now two pieces of lead of this kind inserted in a telephone circuit and separated from each other by only a thin sheet of paper would allow a telephonic conversation to go through between them without a great deal of loss. Separate the two sheets by half an inch, however, and conversation becomes almost impossible, while at four inches it becomes quite so.

Third Proposition—Upon increasing

FIG. 78.—ELECTROSTATIC INDUCTION NEUTRALIZED.

the size of these plates, however, it becomes possible to hear a conversation even though the plates should be placed a foot apart.

Now the two sides of a circuit or two wires running side by side act and react on each other in the same manner that the plates of a condenser would and, gathering strength as the parallel distance increases, the electrical vibrations on one wire will affect the other to the extent that conversations become badly mixed unless measures are taken to prevent it.

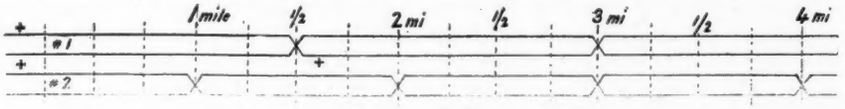


FIG. 79.—CIRCUITS ARRANGED TO COUNTERBALANCE STATIC EFFECTS.

It is not often realized what amount of surface two wires may present to each other. Take, for example, the smallest line wires in general use, No. 14 copper, and we find more surface than we might imagine, for a mile of this wire has a surface of 12,672 square inches; taking half of this as the surface exposed, we still have 6,336 square inches on each wire, equivalent to two plates each six feet eight inches square placed, say, one foot apart, which, of course, is still too small to create cross-talk. No. 10 wire has still more surface, a mile being equal to 20,275 square inches on each wire. Taking half of this would still leave us enough to be the equivalent of two plates, each of which is eight feet five inches square, placed one foot apart. A wire as heavy as No. 6 would give us 32,208 square inches, or a surface equivalent of two plates each of which is ten feet seven inches square, and it goes without saying that if the two circuits were an inch instead of a foot apart there would be plenty of cross-talk, but this static effect diminishes as the square of the distance between surfaces.

As to the fourth proposition, a line left lying on the cross-arms or swung through trees instead of tied on the insulators will be much worse than one properly insulated, although there is a point at which leakage and static induction will counterbalance each other and so produce a quiet line. If an approximate balance of these two forces is not attained the leakage will cause cross-talk in one case or increase it in the other. Moreover, it is necessary that the leakage should be uniformly distributed, as it might be in rain-storm or in damp weather, when the leakage would occur in about equal portions at each insulator. Both telegraph and long-distance-telephone operators have noticed that long lines seem much quieter and give better service at night than in the daytime, which is due to the damp night air and dew increasing the leakage slightly, which clears out the static induction as well as the atmospheric charge, which is nearly always present to a greater or less extent.

Leakage on the lines, of course, diminishes the current volume, but preserves the wave form of the impressing current, while static induction tends to destroy it and causes the scrambled articulation noticeable on long lines. Nor is this all, for, as explained before, it causes cross-talk from one circuit to another unless it is neutralized in some way, as, fortunately, it can be by intelligent transposition.

In Fig. 77 it is shown how a series of positive impulses on the A line will induce negative impulses in the B line. In Fig. 78 two lines are shown, in each of which + impulses are made at the same instant, of the same strength and the same wave-length. The effect of this is that the

induced currents from each meet and, to a great extent, kill each other. The only trouble with this is that telephonic waves are not of the same length, or, if they are, they do not remain so for more than a fraction of a second.

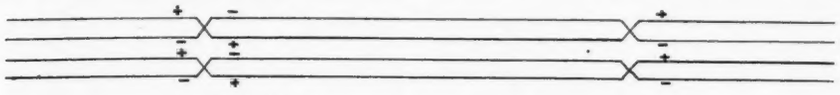


FIG. 80.—IMPROPER METHOD OF TRANSPOSITION.

So far we have referred only to grounded or common return lines, but by experience we find that metallic circuits do not possess more than about half the capacity (the inductive charge a wire receives is called its static capacity) of grounded lines, owing perhaps to the fact that the earth presents so much greater surface, but more than all to the equal distribution of resistance, leakage and current in both sides of the circuit so that the neutral points of each circuit are located in the telephones, where they should be. It might be added that the further a grounded wire is above the earth the less its static capacity, and if it were possible to carry wires two miles above it there would be good talking service from New York to San Francisco.

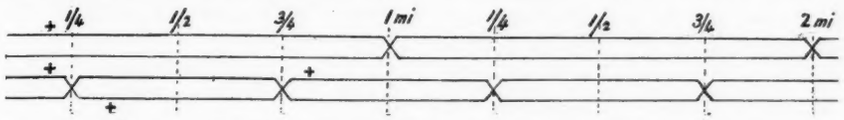


FIG. 81.—A COMMON VARIETY OF TRANSPOSITION.

But even metallic circuits, when run side by side, will influence each other to such an extent that they will become noisy or full of cross-talk, or both. It was soon discovered that if the sides of these metallic circuits were reversed with relation to each other so that they would alternately act in unison and opposition to each other's impulses, the effect was that static induction, with its attendant cross-talk, was smothered and neutralized.

In the following sketches the writer has taken it for granted (in order to make the illustrations clearer) that the circuits being connected to the switchboard in a certain way, the telephones are also connected uniformly, as they must be in central battery systems at least, so that what for simplicity we will call the positive impulse comes to the first or upper line. In practice the odd numbers on the arm are generally the "sleeve" and the even numbers the "tip" side of the lines, so that the presumption that the first impulses to line will pass out on a certain side is not at all far-fetched, even though the current be alternating in character. Turning to Fig. 79 we have two circuits which, for convenience, we have divided into sections of a quarter of a mile each. Starting from the office, which we will suppose to be on the left, we find the two circuits taking their + impulses from the same side of the board, so that we will speak of these two circuits as being in unison. We find also that of the two sides of the circuit nearest each other the + side of No. 2 circuit is sending — impulses into the — side of No. 1 while the — side of No. 1 is impressing + impulses on the + side of No. 2.

This state of things continues for one mile from the office, when No. 2 circuit is crossed over and the + now becomes the — side of the circuit. Between the mile and the one and one-half-mile mark the two — sides of the circuit are opposing each other and mutually tending to destroy the impressed capacity of the preceding four sections, but in the next two sections this is reversed again and we again find them in unison so that the account now stands at the second mile

6 sections in unison,
2 sections in opposition.

This shows a line considerably out of balance but it is made up in the third mile, at the end of which we now find

6 sections in unison,
6 sections in opposition.

We therefore find that, by transposing in this way, the two lines balance each other with their + and — sides every third mile. This is a practical working plan for, say, a bracket line. It will not do to have these transpositions occur continuously at the same places, as shown by Fig. 80, for in this case we find that though the lines are frequently crossed over, yet the two sides are always in unison, so that there might just as well be no transposition at all. In Fig. 81 we have a very common form of transposition, circuit No. 1 being crossed every mile, while circuit No. 2 is turned over every half mile. By following the + and — sides of these circuits we find at the end of the first mile the account standing as follows:

Unison ..... 1 section.
Opposition ..... 2 sections.
Unison ..... 1 section.

This makes the opposing sections equal in every mile instead of every third mile, as in Fig. 79.

Fig. 82 shows an arrangement in which a balance is struck every mile, but, unlike Fig. 81, both transposition sections are of the same length. Thus the circuit No. 2 first breaks at the central point of No. 1 and crosses at the central point thereafter. These transpositions can be made of any desired length provided the same proportionate distances are preserved.

Fig. 83 shows a four-mile chart, and the transpositions occur at the ratio of two to one as in Fig. 81, except that the transpositions occur at the mile and half mile instead of the quarter and three-quarter-mile points. When there are only two circuits the plan shown in Fig. 81 gives the best results, but when there are three or more circuits both should be used.

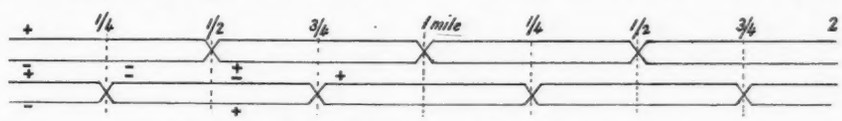


FIG. 82.—ANOTHER COMMON VARIETY OF TRANSPOSITION.

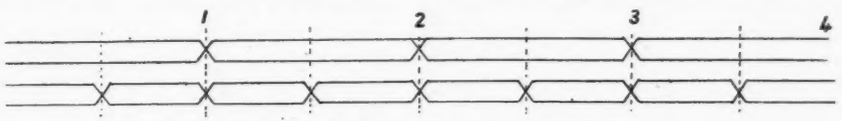


FIG. 83.—FOUR MILES OF TWO-TO-ONE TRANSPOSITION.

Robert Fulton Memorial.

The American Society of Mechanical Engineers unveiled a memorial to Robert Fulton on the afternoon of December 5. This memorial is situated in Trinity churchyard, New York. It is of granite and consists of a shaft about eight feet high and two feet thick. On the face of the monument is a bas-relief of Robert Fulton. Very elaborate dedicatory exercises were held. The Rev. Robert Fulton Crary, of Poughkeepsie, N. Y., a grandson of Robert Fulton, delivered an address in Trinity Church. One of the interesting features of the dedication was the presence of a very large number of the descendants of Fulton at the exercises.

AN ANCIENT STREET RAILWAY.

ADDRESS OF HON. CHARLES S. GLEED, OF TOPEKA, KAN., AT THE BANQUET OF THE AMERICAN STREET RAILWAY ASSOCIATION.

Hon. Charles S. Gleed, director of the Atchison, Topeka & Santa Fe Railroad, was introduced to the American Street Railway Association the night of the banquet, during the convention in this city, in October, in very flattering terms by the president, Mr. W. H. Holmes, of Kansas City. Mr. Gleed's address, in which appears a description of an ancient street railway that should take rank as a classic, is published below:

Mr. Toastmaster, ladies and gentlemen: I have never heard so many false statements put in so few words. When Mr. Holmes picked me up at the Holland House, night before last, and said that he had glued my name to this menu card and had arranged for me to speak to you to-night, I asked him what he thought you had ever done to him. I declined to make a speech and I declined to come. He entered into an argument and reminded me of the Kansas statute which makes it a penitentiary offence for any Kansan to refuse to speak when he gets a chance. (Laughter.) I told him that was not binding outside of Kansas. He then told me he needed help in unloading this convention on the East. You have all noticed how little help in that line he needs. What he could not do, President Vreeland has done. I will, however, cheerfully throw out one suggestion to what they have both said—if you will hold the meeting of this association every year in Kansas City, we out West will guarantee to double the entertainment every time. The children at the Kansas firesides are still talking about the convention of the American Street Railway Association.

I have told you, friends, that I come here reluctantly. My reluctance has disappeared. I am going to stay here to-night, if they will let me. You remember the story about the difficulty the farmer had in teaching his calf to drink. He said that he had to pull its ears to get its nose into the bucket and then pull its d——d tail to get it away. (Laughter and applause.) I presume part of my quite-at-home feeling is due to one fact, which did not occur to me until I sat down by General Eugene Griffin. I was once a street railway president, myself. I presided over sixteen miles of the most remarkable street railway any man ever knew. We had real Kansas mud for ballast, our ties would have been very fine cord wood if they had not been rotten, and I think we could have turned in our rails at about two dollars a ton. We had about three hundred imitation horses, which we fed on curses and put to sleep in the starlight. Our cars were as wide as they were long, and sometimes when they got turned on their trucks we pulled them through the street sidewise. (Laughter.) They had neither paint nor curtains, and their wheels were not even circular. I had an old preacher friend who undertook one day to make the trip out the entire length of the long leg of the line to attend a funeral. When he finally got there, he heaved a sigh and mopped his brow, and, addressing the conductor, said: "My friend, when I die, if my deeds have been ill, and I have not repented, and I go to hell, I want to go by this route and this car. It will be so pleasant to get there." (Great laughter.) And yet it makes me shudder to think how those dinky little cars would kill my fellow citizens. More styles of homicide were committed by those cars than in any other manner I ever heard of. We would find people dead on top of them. We would find people dead inside, of heart failure, probably occasioned by the horses trying to trot. We paid our help with kind words, we passed our dividends, we passed our fixed charges, we passed our taxes, we passed our judgments and then we passed our pay-rolls, and, in fact, we passed everything except something going the same way. (Great laughter.)

And yet, my friends, it all comes back to me to-night that it was General Griffin, who sits here, who transformed that unspeakable road into what was, at the time, the finest electric railroad in the United States. (Applause.) We had not in those days developed the idea of consolidation, and there was one road in that town worse than mine. We could not distribute tickets on that road. Reporters, councilmen and judges were all insulted if we asked them to ride free. I remember sending passes to Charles W. Price, who sits yonder, and he sent them back with the suggestion that I should send a life insurance policy with each ticket. So you see, gentlemen, why it is I feel at home among you. (Laughter.)

I told Mr. Holmes that I should certainly decline to make a speech here to-night on railroads. I told him the subject was too long and my interest in it too great, to permit me to trifle with it on short notice. I am willing, however, to tell you what my speech would be about if I ever do make it. You know there are various views of railroads. Some people never think of a railroad except as a smoke-maker and a noise-maker. Some think of it as a convenience. You remember the two actors who were walking on the tracks of the New York Central after a hard season. One said: "Isn't it lucky we have this fine ballasted railroad to walk on?" "No," replied the other, "if it wasn't for this blamed railroad we wouldn't be so far from home." (Laughter.) Other people think of railroads as mere job-givers, something to be looted. You remember the old sawmill engineer up in Wisconsin at the time of the Burlington strike. He was working for six bits a day, and read about locomotive engineers getting ten dollars a day. He knew how to pull the lever and throttle, and thought he might as well get ten dollars a day, and he went down to Aurora and asked for a job. "What road have you worked on, sir?" "I worked on the St. Paul." That is where the sawmill was. "All right; get into that engine and put her in the roundhouse." He climbed up, dropped over his lever, hung upon the throttle, and the old thing jumped like a kangaroo and went into the roundhouse. As she was about to knock out the side wall, he gave her a little back motion and out she came. He tried it again, with the same results, just saving the roundhouse from being demolished. He came out of the house a second time and the foreman rushed up and said: "What are you doing, I told you to put that engine in the roundhouse." He said: "Don't stand there gassing, I have had her in twice, why the devil don't you shut the door?" (Laughter.)

There is another class of citizens who look upon the railways as means for their elevation. They lose a great deal of sleep over the railways. They think the lines are likely to eat up their children and abolish their firesides and absorb all the money and all the good grub in the country. They lose lots of sleep about these railroads, and you will see them unduly excited about election time.

Now, my friends, when I do make this speech on railroads I shall tell you what my chief feeling is about the whole tribe of railroads. I shall tell you, in impassioned language, that I consider street railroads the greatest missionaries on earth. You may discuss your cylinders and your boiler capacity, the weight of your rails and the style of your ballast, but I will discuss the missionary spirit, the missionary character, the missionary function of the railways of the world. (Applause.) I am firmly of the opinion that if all the missionary agencies of the world had applied ninety per cent of the money they have spent in the last fifty years to building railway tracks barbarism would now be just about annihilated. (Applause.) I shall tell you, when I make that speech, that solitude is death, that isolation breeds barbarism, that unless you permit the civic blood to run you will have no health, no advancement, no prosperity. My heart is aching over the wasted blood of our heroes in the Philippines, but if I had my way the government at Washington would send money there and iron these islands from top to bottom and side to side. The hiss and the song of the trolley, the jerk of the mogul, have more terrors for barbarism than any gun ever invented. (Great applause.) That is merely the text, gentlemen, of the speech I shall make when you have your annual convention at Topeka. I thank you. (Applause.)

It is reported that a new packing plant is to be erected in New York by the Schwarzschild & Sulzberger Beef Company. It is stated that the plant will be operated by electricity and be eight stories in height. By having the plant operated by electric power a large saving will be effected.

THE PRACTICABILITY OF PLACING HIGH AND LOW-POTENTIAL WIRES IN SEPARATE DUCTS IN A COMBINED CONDUIT SYSTEM.

BY CHARLES F. HOPEWELL.*

This brief paper is in the nature of a reply to an article by Captain William Brophy, of Boston, appearing in the ELECTRICAL REVIEW of November 30, 1901. A review of this article shows that Captain Brophy has taken nine columns out of a total of twelve to discuss the subject of Private *versus* Municipal Ownership. Only three columns appear to me to be relevant to the subject of the title.

In this paper I do not intend to discuss the subject or the reasons for the electric companies desiring exclusive and perpetual franchises in the streets. Nor do I expect to touch upon the subjects of competition or taxation. The above are questions for the economist and not the engineer. If, however, the engineer can prove that a combined conduit for high and low-potential wires is practical, then the economist will tell you that the duplication of conduits is an economic wrong as much as the paralleling of railroads. In conclusion I will add, however, a few reasons why I believe in the municipal ownership of conduits.

The engineering propositions that I desire to consider are three. These are the relation of the subject title to method of construction and method of operation of conduits, and the determination of what good engineering practice has shown to be a safe distance for the separation of ducts containing high and low-potential cables. It is good logic to say that if high and low-potential ducts can be laid within three inches or one foot of each other without danger, then it must necessarily follow that there is no advantage in placing them any farther apart—for if a thing is safe I can not conceive of its need to be any safer. There is a decided disadvantage, in one respect, in separating them, inasmuch that by so doing they occupy more space in the public streets, and therefore create a greater tendency toward interruption of travel on such streets.

Before considering this subject further I desire to clearly set forth the difference between an explosion and a burnout in a conduit. An explosion in a manhole, where it almost invariably occurs, is due to the ignition of gas which has accumulated there, either sewer or illuminating gas. The gas can be ignited by an electrolytic spark from a cable sheath or from the wheels of a passing car or other causes. The result is generally the blowing off of the manhole cover, but it seldom results in damage to the cables. These are liable to occur in telephone conduits as readily as in electric light conduits. This might be called an exterior cause, as it results from causes exterior to the cables themselves. Burnouts can be classed as interior causes, as they are caused by the breakdown of insulation in the cables. Such breakdowns result in the melting or fusing of the cables. A distinction should here be made between electric light cables and railway feeder cables. In the former case a breakdown results in a ground and not necessarily in a short-circuit, consequently it does not infer a burnout, except in the case of an Edison system, with its neutral grounded mains. Of course, if there is another ground on a circuit at the time the breakdown occurs you will then get a burnout, but this should be very rare. In the railway system this is different, as one side of the circuit always remains grounded, so that a breakdown almost always leads to a burnout. The severity of this burnout depends entirely upon the method of operation of the system. These burnouts result in heating the air in the manhole and blowing off the cover. The results are much more serious in many cases due to faulty method of construction and faulty operation. The Edison pipe system I shall not consider, as it is already an obsolete system and is fast disappearing.

This leads me now to the question of what I mean by faulty method of construction and operation. Faulty method of construction I consider to comprise all kinds of conduit built of conducting material, such as iron pipe, or ducts with an iron covering where joints every eight feet place the cable in contact with iron rings mechanically connected to such iron cover. In this class of construction one will readily see that a breakdown of insulation immediately charges the entire conduit from manhole to manhole. The current then flows through the breakdown to conduit and from the conduit to the lead sheath of the other cables, thereby destroying them. In tile conduits there is no such liability, for this trouble can not exist.

I desire to call attention to this very important fact, that I have never been able to learn of a breakdown in a cable in one vitrified duct passing directly to a cable in another vitrified duct, unless such passage of current took place in a manhole. There has never been a burnout in Cambridge, although the Boston Elevated Railway Company has twenty-one miles of tile duct in this city and has had cable in it since 1897. Moreover, there has never been a burnout in Roxbury, a part of Boston where such a construction is used, where a defect in a cable in one duct has led to the injury of a cable in another duct. There have been many instances of burnouts in Boston where the current has passed from one cable to another, but they have always been in cement conduit having an iron shell. All the Boston Elevated Railway burnouts have occurred in conduits of such construction.

Cables, instead of being systematically separated in manholes, have been laid up together, whereas they should all be insulated from each other, but, of course, bonded to a ground return wire capable of taking the current of any one cable to such ground return rather than allowing it to go to any other cable sheath. This is necessary to prevent electrolysis.

Faulty method of operation, which has been the cause of a large number of burnouts, consists in not properly watching the cables and forestalling a breakdown in insulation in them where the insulation shows deterioration. Another very prolific source of such trouble is the method of throwing the circuit-breakers at the central station back in again when they have once opened. I have known of an instance in Boston where a circuit-breaker was held in until it burnt out in the hand of the attendant.

In the serious burnouts in Boston on the street railroads in times past, at Sumner street and Atlantic avenue, we found that both conditions were present—namely, faulty construction as well as faulty method of operation. The Boston Elevated Railway Company has since given up the attempt to burn out a cross on its feeders and now leaves the circuit-breakers out after three attempts to close them. Formerly the company lined up its operators at the switchboard and threw the circuit-breakers in, and thus sent their entire central station energy through the cable breakdown in order to burn it clear.

How far should the high-tension ducts be separated from low-tension ducts? I know that six inches is amply sufficient, and I believe that three inches will accomplish the result perfectly.

Mr. C. I. Walker, chief engineer of the Subway Company, of New York, who appeared in favor of the telephone company at a hearing in the Massachusetts Legislature this year, testified on cross-examination that there were over twenty miles of conduit in New York city where high-tension wires were laid in conduit in the

*City Electrician of Cambridge, Mass.

same trench with low-tension ducts, separated by only fourteen inches of dirt, and that they have never had any difficulty, and, furthermore, that they have a mile on Fifth avenue where these two classes of service are only separated by six inches and they have never had any trouble from current passing from any duct in the high-tension to any duct in the low-tension, even although the ducts are made of wrought iron and have been in use many years.

At the same hearing Mr. Eaton, the electrician of the Cambridge Electric Light Company, testified on cross-examination that a combined conduit system was practicable.

At this hearing also, Mr. David R. Walker, chief of the electrical bureau of Philadelphia for a great many years, testified that electric light wires and telephone and telegraph wires have been in successful operation in adjacent ducts in Philadelphia for over ten years. The ducts used were of wood or tile.

In Rochester, N. Y., the competing company to the Bell company has had over 250,000 feet of telephone cable in the electric light ducts since May, 1900, and has experienced no difficulties in operation.

Baltimore, Md., which is now building a combined municipal conduit system, has just rented 100,000 feet of conduit space to the American Bell licensee company after a long period of litigation.

In Washington there are 14,000 feet of high and low-potential wires in the same conduit in successful operation.

In Chicago the city has low-tension wires in the same conduit with wires of 8,000 volts in successful operation. That city has, moreover, recently made an agreement with the electric light company and the telephone company to build a combined conduit system on Archer avenue for their joint occupancy.

The subject of practicability of the operation of high and low-potential wires in the same conduit has been investigated by two experts and competent commissions. In 1892 President Harrison appointed a commission comprising Andrew Rosewater, Professor Henry A. Rowland and Lieutenant Francis A. Shunk, of the Engineering Corps, to report upon the subject of conduits for Washington, D. C. In their report they recommended a combined conduit system and further stated that the voltage need not be limited.

Baltimore, Md., in 1896, also appointed a commission to consider the subject of conduits and their investigation led them to the same conclusions as were found by the Washington commission. In consequence of this report Baltimore has appropriated over $1,000,000 for conduits and has already expended over $600,000 in actual construction. They are building a combined conduit system there.

In Boston I know of three distinct conduits laid in a nine-foot space between the car tracks and a gas pipe. The conduits are owned, respectively, by the street railway company, electric light company and the telephone company.

At a hearing before the Mercantile Affairs Committee of the Massachusetts Legislature the past year, the only two engineers upon that committee, one a consulting electrical expert and the other a civil engineer, both reported favorably upon the Cambridge conduit bill, which contemplated a combined conduit system. This was after a hearing lasting seven sessions this year and after the telephone company had brought in its own experts, one of whom—Mr. Walker, of New York city—I have already quoted, and had argued its side of the case and quoted Boston for a city having separate conduit systems.

In closing, I would state as facts: We have high and low-potential wires occupying adjacent ducts in conduits in New York, Philadelphia, Chicago, Washington, Rochester (N. Y.), and Baltimore will soon have some if they have not some already. Furthermore, that these have been in successful operation for many years past and have given no trouble because of such joint occupancy.

It is an old adage that "the proof of the pudding is in the eating," and from the above facts I do not see how any one can conclude otherwise than that a combined conduit system is safe and practical, for surely if five per cent will operate successfully then the other ninety-five per cent will operate in like manner.

The alternative of such a combined system is well illustrated in a colored plan, dated January 21, 1901, and accompanying the report of the Boston Wire Department for the past year. This drawing shows the subsurface conditions existing on State street, which is the main "financial street" of Boston. It well represents Boston's and Captain Brophy's conglomerate aggregation of individual conduits, for I shall not deign to designate such a collection with the name "system."

Space will not permit me to consider properly the subject of manhole construction and the discussion of whether separate, individually divided or single, twin or multiple manholes should be used. It is on these points only that I can conceive that there should be a difference of engineering opinion, for the other question of separation of ducts has been settled by facts.

In conclusion I wish to give my reason for the municipal ownership of conduits, although properly it has nothing to do with the subject under consideration. I bring it forward at this time, however, in order to reply to the greater part of Captain Brophy's paper.

Conduits are a public utility and therefore adapted to public ownership.

Conduits, being of a permanent nature of construction, require no operating department for their maintenance. They are therefore best adapted of all public utilities for municipal ownership.

The companies own, operate, install and care for their own cables under municipal supervision, and, as there is no divided authority, accidents are minimized, both for that reason and because of less duplication of interests.

A municipal conduit system will prevent the monopolization of the subsurface and the repeated digging up of the streets and will bury all classes of wires at the same time.

A municipal conduit system is cheaper to construct than several conduit systems and will, therefore, admit of a more general adoption of conduits than would be possible under private individual ownership.

Owing to the less cost of municipal conduits underground service connection can be made with each individual subscriber and consequently dispense with the erection of poles on our public streets for distributing purposes.

The past year the following cities of Massachusetts petitioned the state Legislature for the right to construct municipal conduits: Cambridge, Lowell, Worcester, Springfield, Pittsfield, Fitchburg, Brockton, Quincy, Everett, New Bedford, Gloucester and Melrose. The lower branch of the Legislature passed such a conduit bill, but it was defeated in the Senate. It will, however, be brought up again this coming year.

From the personal study and investigations carried out in many of the largest eastern cities for the past six years, I have no hesitation in saying that any unbiased commission which would consider this subject would, like those in the past, be convinced of the absolute practicability of a combined conduit system.

A fellowship in physics has been established at the University of Pennsylvania by the Frazer family in honor of John Fries Frazer, who was formerly a professor of natural philosophy in that institution.

The New Terminal System of the Pennsylvania Railroad in New York.

ANNOUNCEMENT was made last week that the Pennsylvania Railroad, whose terminus in the vicinity of New York is now in Jersey City, connection with the metropolis being maintained by three lines of passenger ferryboats and several routes over which freight cars are ferried on floats, has completed its plans for the construction of a terminal station in the Borough of Manhattan, connected by means of a system of tunnels running on the one side under the North River to its present tracks in New Jersey, and on the other side under the East River to Brooklyn, there to make connection with the system of railways covering the territory of Long Island, which has lately passed under the control of the Pennsylvania Railroad.

In brief, this system consists of two single-track steel tubular subways under and across the North River to a point near Eighth avenue and Thirty-second street, in the Borough of Manhattan, and thence three tunnels across Manhattan Island and under the East River and a part of Brooklyn, converging at a point near the present Long Island Railroad terminus in the district known as East New York, whence a subway will lead northerly and easterly to the Thompson avenue station of the latter railroad, and there connect with the ground level system. Throughout the entire system trains will be operated by electricity to the exclusion of all other forms of motive power.

The physical conditions which determine the equipment of this system are in some degree extraordinary and in all degrees difficult. The channel to the North or Hudson River, which at the point proposed for tunneling is more than one mile in width, is filled to a considerable depth with mud of a tenacious consistency overlying a river channel of gneiss rock of great hardness. Through this mud and above the rock bottom of the channel it is proposed to drive the steel tubular tunnels, and on account of the possibility of the tunnels either flowing up through the mud or being weighted down by the trains which traverse them, it is further proposed to support these tubes upon piers reaching down to bedrock and thus constituting a structure which will practically form a submerged tubular bridge. The average depth of the mud above the rock bottom of the river is one hundred feet. The tunnels will be eighteen feet six inches in diameter inside, and will be supported at appropriate intervals upon piers of concrete and structural steel. In order to attain easily the grade necessary for the construction of the tunnels their portals on the western side will be at a point in the Hackensack Meadows some distance back from the river shore and of the Bergen Highlands, upon which the town of Jersey City is built. The exact length of these tunnels has not yet been stated, but the first section from the Hackensack Meadows will be considerably over two miles long.

The present intention is to construct the terminal upon a plot bounded by Seventh avenue and Tenth avenue, Thirty-first and Thirty-third streets, in the Borough of Manhattan, this site being about 1,500 by 520 feet in dimensions and of a capacity sufficient to contain more than two miles of terminal platforms. The whole site will be excavated to the tunnel depth and twenty-five parallel tracks will be laid in the bottom of the excavation, with intervening platforms. Across the bottom level upon which the tracks are laid will extend a bridge one hundred feet wide, from which stairways will lead to the various platforms and trains, while at each end of this great bridge a graded carriageway will lead down to it and midway stairways and elevators will be provided for passengers.

The station will be practically of a three-deck type, and as it will be a through station, open at both ends, it is expected that the handling of trains in it will be greatly facilitated. The actual terminus of trains will probably be made at the Long Island end of the subway, which will consist practically of a dead-end station for the electric service. At this point there is sufficient room for the construction of the necessary number of dead-end tracks to handle the enormous through and suburban business that will be conducted from this station. The steepest grade contemplated in the subway system is 1.5 per cent. Under the North or Hudson River the top of the tunnels will be forty-five feet below the river bed, and at the point where the grade turns upward toward the station in Manhattan the tunnel will be eighty feet below high-water mark. The tracks in the great central station described above will be forty-five feet below the ground surface, while at Broadway the tunnels will be fifty-five feet below the surface, and sixty feet below at the point where the present New York subway system is crossed. Under the East River the tunnel cutting will be in solid rock of circular section. The Manhattan section, crossing Manhattan Island, will be of the inverted horseshoe form, the cuttings here being for the most part in the solid hard rock which forms the substratum of New York city.

So far no information has been given out as to the system of electric traction to be employed in this magnificent piece of work. It is a curious commentary upon the enormous advance lately made in electrical engineering that this work has become possible only within the last few years, and that the conditions now laid down for its successful completion could not even have been anticipated by civil engineers of the utmost ability five years ago. It has long been possible to construct such tunnels as are here contemplated, but their operation by steam-driven locomotives would have been utterly impracticable and on that account numerous plans for bridging the tremendous expanse of the North River have been in consideration for more than ten years. The cost of a bridge in comparison with that of a system of tunnels is enormous, and it is not likely, if this station is constructed upon the lines laid down above, that bridges will be seriously undertaken. It is expected before long the railroad managements interested will make public the designs which doubtless they already have in mind for the electrical equipment of this subway, and it is confidently believed that at the same time further designs will be exhibited showing the practicability of extending the electrical equipment far beyond the present suburban limits of the railroads which will centre at the new station—possibly as far as Philadelphia on the one side and the remoter resorts of Long Island on the other. The conception of this system opens up the opportunity for speculation of a most interesting and far-reaching character. The new work may be regarded as the greatest step that has ever been taken in the direction of electrical equipment of main-line railroads, and all parties interested in it, not only the railroad managements and the general public but also the craft of electrical engineers at large, are to be congratulated upon the installation of this epoch-making and almost spectacular piece of engineering—one that beyond doubt is to mark the beginning of a new order of things for American railways.

Wireless Telegraphy Across the Atlantic.

MARCONI RECEIVES A MESSAGE FROM ENGLAND AT NEWFOUNDLAND, A DISTANCE OF 2,000 MILES—HIS SPECIAL CABLEGRAM TO THE "ELECTRICAL REVIEW."

On Sunday, December 15, a public announcement was made in several newspapers that Mr. W. Marconi had succeeded in receiving signals between a station called Signal Hill, on Newfoundland, and a station at Poldhu, Cornwall, England, the two being separated by a distance of about 2,200 statute miles.

The signals exchanged consisted of a single letter of the alphabet—the letter "S"—repeated at intervals of five minutes, and were received at the Newfoundland stations by means of a receiving wire supported upon kites at a considerable height in the air. The details of the Cornish station are not at present available, except that, as described in the British technical press, this station consists of a number of high poles or masts equipped with sending apparatus and probably operated in parallel. Immediate data of the receiving apparatus are also unavailable at the present writing. Mr. Marconi has cabled personally to news agencies and newspapers in New York confirming the statements that signals were received on two days, and it is regarded that this information is definite and reliable.

Later an important confirmatory cablegram to the ELECTRICAL REVIEW was received.

It is understood that the experiments were largely interfered with by bad weather prevailing on both sides of the Atlantic, but that they are being continued as circumstances permit and that very shortly further announcements of a significant character will be made.

MARCONI'S CABLEGRAM TO THE "ELECTRICAL REVIEW."

The ELECTRICAL REVIEW cabled its congratulations to Mr. Marconi on Monday of this week, and requested his personal confirmation of the wonderful success he had achieved as chronicled in the daily press of Sunday and Monday. His reply was received on Wednesday and appears below. It will be observed that he appreciates now, as in the past, that scientific advancement should be announced through the medium of scientific bodies and the technical press. The ELECTRICAL REVIEW again extends to Mr. Marconi its cordial and appreciative congratulations:

[*Special Cablegram to the* ELECTRICAL REVIEW.]

ST. JOHNS, NEWFOUNDLAND, December 18, 1901, 12.08 P. M.—Sorry out of town yesterday and could not reply.

Confirm that signals were received here with certainty and distinctness by means of my system of wireless telegraphy direct from Cornwall, England.

Receiving wire here supported by kite about 400 feet high.

Transmitter in Cornwall much more powerful than that previously used for communicating 200 miles.

Shall read paper on subject before scientific society as soon as possible.

MARCONI.

MARCONI'S STATEMENT TO THE DAILY PRESS.

The New York *Herald* on Tuesday of this week publishes the following letter from Mr. Marconi, written at St. Johns:

I have to confirm the despatch of your correspondent regarding the receipt by me here of signals direct from Cornwall. The exact particulars are as follows:

Before leaving England I arranged for our long-distance station near the Lizard to signal me the letter "S" repeatedly for three hours when I had advised them that I was ready to receive the same. I cabled on Monday that all was in readiness and asked the signal to be sent at short intervals between three o'clock and six o'clock, Greenwich time, and to be continued each day until ordered to stop. This time would correspond approximately with half-past eleven to half-past two here. I received on Thursday indications of the signals at 12.30, and with certainty and unmistakable clearness at 1.10 quite a succession of "S's" being received with distinctness. A further number were received at 2.20, the latter not so good. Signals were received Friday at 1.28 o'clock, but not so distinct as on Thursday.

I am of the opinion that the reason why I did not obtain continuous results were: First, the fluctuations in the height of the kite, which suspended the aerial wire; and, second, the extreme delicacy of my receiving instruments, which were very sensitive and had to be adjusted repeatedly during the course of the experiments.

When a permanent station is installed here I will not be dependent upon fluctuations of the wind, and I am confident of making the signals strong and reliable—that is, not requiring such delicate and sensitive receiving instruments by employing much greater power at the sending station.

I must go immediately to England to make arrangements for employing more power at the sending station and I trust in a very short time to establish communication between the two continents in a thoroughly reliable and commercial manner.

(Signed) MARCONI.

St. Johns, Newfoundland, December 16.

INTERVIEW WITH THE MANAGER OF THE MARCONI COMPANY.

Mr. H. Cuthbert Hall, of London, manager of Marconi's Wireless Telegraph Company, Limited, who is in New York city, was interviewed by a representative of the ELECTRICAL REVIEW.

In response to an enquiry Mr. Hall stated that the receiver employed by Mr. Marconi at St. Johns, Newfoundland, was of a new type recently adopted.

"Is the system employed syntonic or can its signals be received by any coherer and proper vertical circuit within range?" questioned the ELECTRICAL REVIEW representative.

"Yes, it is syntonic," replied Mr. Hall. "The signals could be received only by our coherer connected to a receiving circuit accurately tuned to the transmitting circuit. The difficulty of providing for this is very great. There are many variable factors in the production of a given tune and the details of these must be known at the receiving end. When known they can not be reproduced without considerable outlay and highly skilled adjustments."

It was learned that Mr. Marconi expects to sail from Newfoundland direct for England on Saturday of this week unless the action of the Anglo-American Telegraph Company, in opposition to further experiments, should compel a change of plans.

OPPOSED TO FURTHER EXPERIMENTS.

News despatches from St. Johns, Newfoundland, under date of December 17, state that solicitors of the Anglo-American Telegraph Company have served legal documents upon Marconi. By these documents he has been notified that the Anglo-American Telegraph Company possesses a monopoly of the telegraph business within Newfoundland and its dependencies. It is demanded that his experiments shall cease forthwith or the company will apply to the Supreme Court for an injunction restraining him from carrying on further trials.

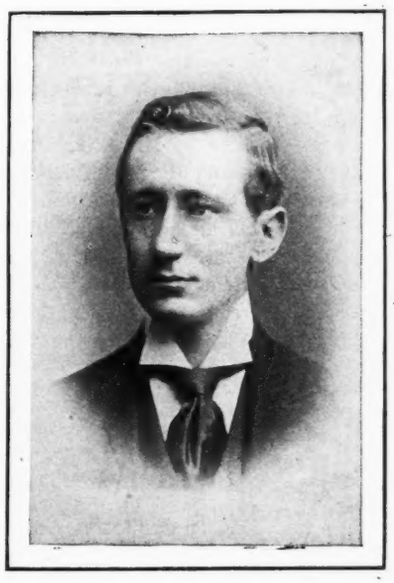
The announcement coming from official sources that wireless telegraphy has at last succeeded in demonstrating its ability to transmit an intelligible signal across the Atlantic Ocean, over a distance of about two-thirds that occupied by Atlantic steamships in their course between New York and points on the British channel, has created a sensation of the most profound description. From a certain point of view there is no reason for accepting this statement with any spirit of incredulity or permitting it to be made the foundation of any sensational rumor; the reason is that this achievement was to have been expected, and that records of re-

cent successes with long-distance transmission of signals by this particular variety of apparatus should have prepared the public mind for the reception of this further intelligence. But, notwithstanding any preparation which might have been made, the news that the Atlantic has been bridged with another method of electrical signaling is one that can not fail profoundly to impress popular thought and to register itself as one of the significant milestones that mark the progress of engineering.

Men who are still in the prime of life remember the incredulity and lack of faith that marked public appreciation of the efforts of those who laid the first transatlantic cable. The occasion of the transmission of the first despatch by the cable was made one of public rejoicing in the United States and in Great Britain and the date, July 22, 1866, is one that should be remembered as among the most important in the annals not only of electrical progress, but of civilization. Assuming, as well may be done, that there is no mistake in this case and no misconception based upon apparent results that may have been interpreted into genuine significance, the date December 14, 1901, also marks a period of the utmost significance.

It is not becoming at this time, with the meagre information at hand, to discuss at any length the immediate possibilities of transatlantic signaling by electrical waves. If this achievement is as real as it appears to be, it is indubitable that sooner or later practical and commercial use will be found for a system with such possibilities. In the meantime such an astonishing performance may well enlist the admiration of the scientific and technical world.

The most immediate consequence that seems to be promised from these experiments is the possibility of keeping constantly in touch with ships on the transatlantic passage. If the possibilities of the new system are limited to this result alone, then it will have accomplished something that the mercantile and shipping world has long desired and that can not fail to prove of the utmost value and importance to the public at large. If, several years ago, when the steamship Umbria broke her shaft in mid-Atlantic and limped into port more than three weeks overdue, some word could have been sent of her condition and position it would have relieved an intense anxiety that was felt in at least two countries. The value of such a system in war is practically incalculable and will doubtless lead to a revision of naval codes of strategy. Notwithstanding the object lesson of wireless telegraphy, which has been before the public for some time, it is still too early to discern the practical value of such an extension as is indicated by Mr. Marconi's experiments.



MR. WILLIAM MARCONI.

In these closing days of the first year of the twentieth century it is interesting to note that the progress of the electrical arts during the year has been at least as great as during any other year since these arts assumed commercial importance. In the period since last January we have had Professor Pupin's revolutionary discovery concerning telephone circuits, making the latter possible for lengths hitherto undreamed of; we have had the announcement of the new storage battery, due to Mr. Edison, which it is believed will go a long way toward solving some of the most difficult problems confronting engineers; we have seen a great European government interest itself in the question of main-line traction at high speeds and conduct experiments upon an enormous scale to demonstrate the already well-believed practicability of such methods; we have seen works of engineering aggregating an expenditure of several hundred million dollars inaugurated, using practically new methods of electrical engineering as the basis of their development, these including electric railway, electric power transmission and electric lighting; and at last we have seen an entirely new method of signaling proving its competence to take its place in rivalry as an established method for the annihilation of space and time.

Electric Railways in Saxony.

The following information concerning electric railways in Saxony has been sent by United States Consul J. F. Monaghan, at Chemnitz: The traffic on the electric street railways of Saxony has increased about 400 per cent since 1896—taking into account the number of persons carried, the number of cars, and the capacity of the motors—and 150 per cent so far as the length of the railways is concerned. The length amounts to 356.33 kilometres (221.4 miles), divided as follows:

In—	Lengths. Kilometres.	Miles.
Dresden	118.09	73.3
Leipzig	149.31	92.7
Chemnitz	38.64	24.0
Zwickau	15.23	9.4
Plauen in Voigtland	4.86	3.0
Schandau	8.30	5.1
Meissen	4.66	2.8
Loessnitz	7.22	4.5
Dresden Suburban	3.51	2.2
Leipzig External	5.92	3.6

The number of motor cars at the disposal of all the railroads amounted at the end of 1900 to 844 without and 184 with accumulators, and 403 attachable cars.

There were 147,645,690 persons carried in 1900, and the number of accidents amounted to 338. There were 23 collisions with railroad cars, 74 with ordinary wagons, and 139 with pedestrians, horseback riders and bicycles.

In Chemnitz, especially, the railways are well patronized by the working classes, as it enables them to live in the suburbs. The usual fare is but ten pfennigs (2.38 cents). The line in Chemnitz paid fifty-two marks ($12.37) last year for every 100 marks ($23.80) invested.

The judges' award in connection with the motor-car trials at Glasgow, in September, has been issued. These trials, it will be remembered, were noteworthy by reason of the circumstance that no electric car was entered as a competitor. It will be noticed that the Locomobile Company's steam car, an American importation, has received a gold medal in the class not exceeding £250 cost.

The Transpacific Cable.

To the Editor of the Electrical Review:

Referring to the editorial article entitled "Manufacturers and the Transpacific Cable," in your issue of December 14, you will understand that in order to equip a plant for the manufacture of submarine cables, one of the first essentials is tanking facilities. In other words, as the cable is made it should be coiled into water-filled tanks and tested each day, not only to discover faults, but to ascertain if there is any deterioration in the dielectric. From these tanks, according to capacity, say from 1,000 to 3,000-knot lengths, the cable should be transferred directly to the cable-ship—the deep-sea cable going into the vessel first, then the intermediate cables, then the shore ends, which is the order in which they are to be taken out. The deep-sea cable is usually smaller in size, the intermediate cable—that is, the one between the deep-sea and the shore ends—is heavier, and the shore ends, being double armored, are the heaviest; these are generally laid first, then the intermediates, and the deep-sea cable is laid last.

There is no difference in the manufacture of submarine cables except as to size, the method of manufacture is precisely the same—there is no secret process whatever that would prevent an American manufacturer with the proper facilities making a Pacific cable. We lack the facilities, not the skill. These facilities would comprise the machinery, etc., for turning out, say, twenty-five knots per diem, and tanking it at the shipping point.

If my memory serves me correctly, the English, French and German manufacturers have about forty cable-ships, all told, flying their respective flags, while there is not one flying the American flag. I understand that the Western Union Telegraph Company has one for the laying and repairing of short cable lengths, but I do not think it flies the American flag.

There is no reason why the United States should not support one or two cable-ships for deep-sea work; if this is too much then they should have at least one or two vessels attached to each squadron, containing cable tanks and proper appliances for raising, laying, overhauling and repairing submarine cables.

There is a mention of submarine cable requirement in President Roosevelt's message, which you might look over.

As to old army transports, or any other old ships, being transformed into cable-ships, a great many years before our time our ancestors were advised against putting new wine into old bottles, or new cloth into old coats.

In reference to the making of cables on the Pacific coast, I doubt if it would be advantageous for two reasons: First, there are a great many short-length under-water cables required on the east coast—more at this date than on the west coast. Second, the transportation of the raw materials would more than offset any cost of transportation of the manufactured article when shipped through the Suez Canal, and this eastern manufacture would be still more economical when the Isthmian Canal, now a probability, would be completed. Still, the growing demand for cables on the west coast may make a cable plant advisable there in the near future, and our western people would no doubt be pleased to pride themselves on making the first American Pacific cable.

Manufacturer.

New York, December 14.

Knobs on Buildings.

To the Editor of the Electrical Review:

I have been following with interest and pleasure the very able serial article in the Electrical Review by Mr. A. E. Dobbs on "The Construction of Small Telephone Exchanges," which is of value for its comprehensiveness and general accuracy. I was, however, rather surprised to see the following statement in the article on this subject in your issue of November 30: "In putting these knobs on buildings, the best method of fastening them on is by means of four-inch wire nails, with a leather or rubber washer under the head to prevent their splitting the insulator. This is a much quicker and easier way than using screws, and holds much more securely."

I have had occasion to observe closely this method of fastening used outdoors and, while I agree with Mr. Dobbs that it is quicker and easier than using screws, I think he is in error in stating that it makes a more secure fastening. As the leather washer is deteriorated by the alternate wet and dry weather and by the rusting of the wire nails, it is not a secure nor durable fastening for porcelain wire supports—two essential qualities possessed by the screw and which are of the utmost importance in electrical construction work of all kinds.

Edward Sullivan.

Brooklyn, N. Y., December 16.

Seeing by Wire.

Another name has been added to the list of those who have invented apparatus for long-distance vision by wire. This time it is a Dr. Sylvestre, who, says the *Independence Belge,* of Brussels, was born an American and is naturalized a Frenchman. He claims to have invented a "spectrograph," which enables a person using a telephone to see his interlocutor. It is stated that official tests have been made and that the King of the Belgians is shortly to see the apparatus.

Views, News and Interviews.

Professor Pupin is of the opinion that Marconi's success in transmitting a message 2,000 miles by space telegraphy would indicate that the curvature of the earth does not interfere with communication by aerial electric waves.

It has been proved that woman can accomplish almost anything under extraordinary circumstances. News comes that the superintendent who had charge of constructing a telephone line from Pollock, S. D., to Fort Yates, experienced great difficulty in securing labor. Finally, several Russian women, who were accustomed to farm work, volunteered their services and the line was put up without further difficulty.

A maker of a well-known form of circuit-breaker, consisting of two magnetically operated single-pole breakers arranged together on a single slab of slate, has recently been notified by one of his customers of a decided improvement which the test of practice has suggested in the instrument. Visiting a recent installation he was surprised to find that the instrument had been sawed in two and its two halves placed on opposite ends of a long switchboard. It was explained to him that only a man with a reach like Fitzsimmons could hold one circuit-breaker in and operate the other as had been the too frequent custom in times past.

A novel use to which magnetism has been put recently is that of stimulating growth. Professor Herdman, of the University of Michigan, has been recently investigating the effect of the magnetic field of force on human beings and animals. For this purpose what might be termed a solenoid cage was employed. For the experiments with animals guinea pigs were used. They were divided into two groups. Each group was subjected to conditions in all respects similar except that from five o'clock each evening until midnight one group was placed in the solenoid cage and subjected to a magnetic bath. An alternating current was passed through the solenoid. Professor Herdman states that the animals which were subjected to the effects of the current began to outstrip the others in weight at the end of the first week and there was a gain of from eighteen to twenty-four per cent in favor of the animals which had been subjected to the magnetic field each succeeding week until they neared the period of full development, when the weekly gain became perceptibly less.

A New Rail Joint Testing Instrument.

For the successful and economical operation of street railways a proper rail return is extremely important. The great difficulty in ensuring a return of the currents by the track is due to the resistance introduced by the joints.

The instrument shown in Fig. 1 is the invention of Mr. Roger W. Conant, of Cambridge, Mass., who has had a long experience in street railway work. The operation of this apparatus is simple, rapid and efficient. The current already on the track is utilized, and no matter how variable the current may be, since the variation through the joint and adjacent rail is precisely the same, it introduces no error.

The operation of the instrument will be understood from Fig. 2. The operator directs his assistant to strike his two connecting poles into the rails spanning the joint, with about three feet between the poles. He then strikes his indicating pole into the rail, say, four feet from the centre pole, and, listening at the telephone attached to the box, which has a continuous interrupter in circuit, he throws a switch alternately to right and left and compares the two sounds heard from the joint and four feet of rail. Finding, in the above case, that the sound from the joint is louder, he shifts his pole so as to span a greater length of rail. When the sounds are found to be approximately equal, a final test of balance is made by lifting the switch on the box in the middle position, when no sound should be heard. In case a slight sound is noticeable he shifts his pole until it disappears entirely. In this manner the length of rail equivalent to the joint from which, if it is desired, knowing the weight and composition of the rail, the resistance may be calculated.

Under ordinary conditions it is said that two men can test about two joints per minute, or about 1,000 joints per day, which is equivalent to three miles of double track with thirty-foot rails. A greater mileage than this can be covered in a day, if desired, by establishing a standard above which joints are called "bad," and below which they are passed as "good." In this case the men simply walk along the track and place the chisels at the standard, say, five feet, and call all joints bad which give a louder sound than five feet of rail, and pass those that equal or are less than that sound. In this manner there is no shifting of the poles and the joints are tested very rapidly.

This apparatus has stood the test of continued operation in practical service, and is now used by some of the largest railways in the country.

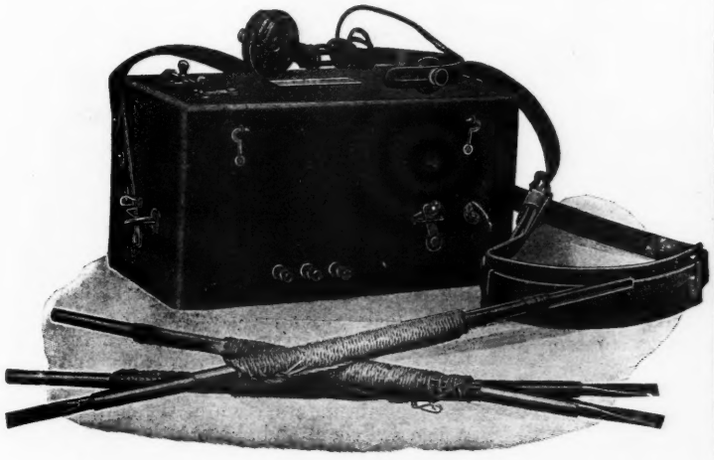


FIG. 1.—A RAIL JOINT TESTING INSTRUMENT.

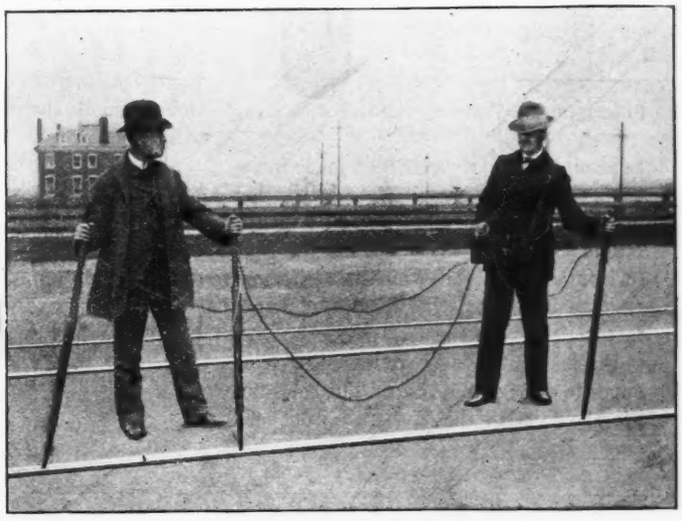


FIG. 2.—SHOWING OPERATION OF RAIL JOINT TESTING INSTRUMENT.

New Mexico Cable.

It is reported by United States Consul Canada, of Vera Cruz, that the Mexican Government has contracted with the Safety Insulated Wire and Cable Company for a submarine cable to be laid between Vera Cruz, Frontera and Campeche. The cable is to be 472 nautical miles long; there must be enough to reach a depth of forty-nine feet in the port of Campeche and sixty-five feet in the ports of Vera Cruz and Frontera. It is to be made of nine copper wires, protected by sixteen galvanized-iron wires for the deep-sea and eighteen additional steel wires for the coast. The manufacture of the cable will be under the supervision of the Mexican Government. The company is to receive for the work $600,000, gold, of which $283,000 is to be paid when the cable is placed in service and the balance in two and four months thereafter. The cable must be ready for service on April 2, 1902.

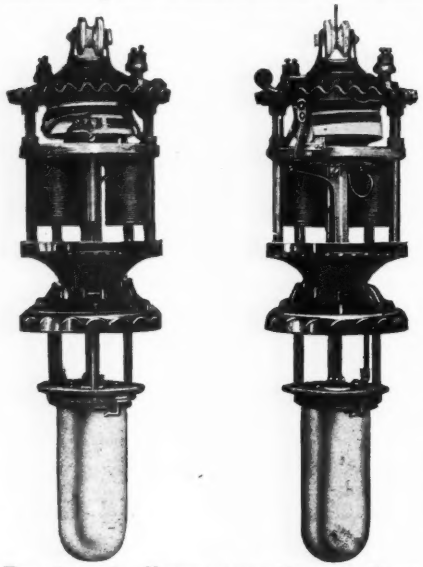
Importance of Using the Metric System.

The following paragraph, taken from the report of United States Consul Skinner, at Marseilles, France, illustrates aptly the need for bringing the metric system into general use as soon as possible: An incident occurred during the year which is worth noting, as illustrating the desirability of the adoption of the metric system in the United States, which, except Great Britain, is the only important manufacturing nation still employing the old system.

In August of last year, the United States naval collier Scindia arrived at this port with boiler tubes burnt out, and under urgent orders to proceed to Manila. The ship came to Marseilles, as it was considered—and, in fact, was—the port best equipped to make the absolutely essential repairs. Every facility was offered for the prompt refitting of the boilers by local contractors, but it was found that all the tubing in the city had been manufactured in France and according to metric dimensions, and none of it could be utilized in the Scindia's boilers without forcing the shells. There was the variation of a hair's breadth in the dimensions, but it was sufficient to prevent the work from being accomplished, and orders had to be cabled to the United States for material, which was brought over on one of the German steamers—probably at express rates—and delivered at Naples, where the repairs were eventually carried out. The ship was delayed two or three weeks in consequence of the fact that her boilers had been built upon a scale of feet and inches, while European tubing was manufactured according to the metric system.

Direct-Current Enclosed Arc Lamps.

The lamps which are shown in the illustrations on this page embody the results of long experience, and possess many interesting and excellent features. As far as possible the parts have been made interchangeable, and it will be noticed that many of the parts which are used in different portions of the lamps are identical in form and material, which is a great advantage both from the user's and manufacturer's standpoint.



FIGS. 1 AND 2.—VIEWS OF THE OPPOSITE SIDES OF THE LAMP.

Figs. 1 and 2 show views taken from opposite sides of the lamp. The solenoids are shown with the U-shaped iron core, which regulates the current and voltage of the armature and actuates the feeding mechanism. This form of regulating electromagnet is said to have been found superior in many respects to the single solenoid type. The air dash-pot, which is located between and slightly forward of the solenoids, is shown in Fig. 1. When the lamp case has been removed it is open to inspection. The withdrawing of two screws permits the removal of the case. The series resistance is shown in the upper part. It consists of a helically coiled wire supported throughout its entire length by a deep-grooved thread upon the surface of a well-vitrified porcelain cylinder. A portion of the square tube forming the guide and shield for the upper carbon connector may be seen in Fig. 2; also parts of the quick-break gravity switch, with a special feature securing quick, positive action without the use of springs.

FIG. 3.—TUBULAR GUIDE AND SHIELD.

In Fig. 3 a view of the tubular guide and shield for the upper carbon connector with one side removed is depicted, which shows the sliding or movable carbon connector and the folded carbon ribbon forming a metallic connection between the tube and holder. The alignment of the carbon is preserved by this tubular guide. It also forms the limiting stop for the downward movement and shields the folded copper ribbon from injury. The tube, together with the connector and ribbon, can be taken out of a lamp by first removing the gas check-plate and then the two screws which hold the tube.

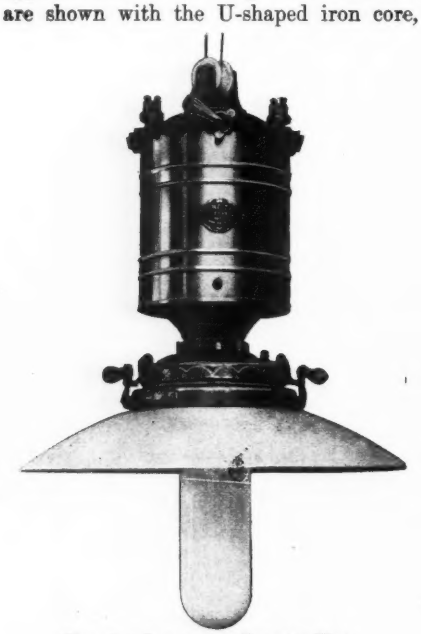


FIG. 6.—LAMP FOR INDOOR USE.

FIG. 7.—LAMP FOR FACTORY USE.

Two views of the porcelain cylinder for supporting the resistance coil are shown in Fig. 4. The groove for holding the coil is deep, so that the coil can not easily be displaced. The opening on the inside of the cylinder is also shown, with the lugs projecting inwardly for attachment to the top of the lamp.

In Fig. 5 a view of the tripod lower carbon holder is given. By this three symmetrically disposed pathways for the passage of the current by the arc are formed, which prevents its deflection and the uneven burning of the carbons. The lower carbon holder is secured to the side rods by screw clamps and can be quickly removed in case of need.

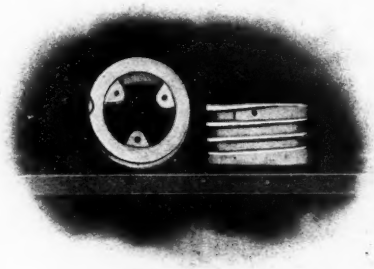


FIG. 4.—TWO VIEWS OF PORCELAIN CYLINDER.

FIG. 5.—TRIPOD LOWER CARBON HOLDER.

Two very neat forms of lamps, one for indoor use and one for factory use, are shown in Figs. 6 and 7. In Fig. 8 a diagram of the electrical connection of the lamp is shown. The marks plus and minus refer to the terminals of the lamp and indicate the direction of the current. A is a switch, B and C are carbons, E is the adjustable connection between the solenoids, F and D the solenoids and G the adjustable shunt for the resistance. These lamps are manufactured by the Western Electric Company, of Chicago, Ill.

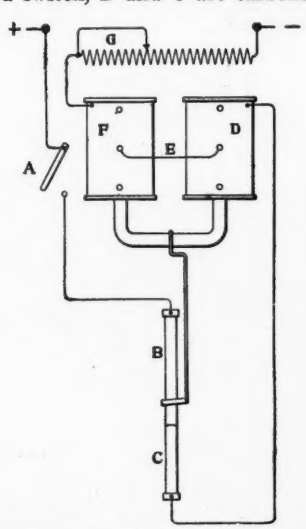


FIG. 8.—DIAGRAM OF ELECTRICAL CONNECTIONS.

New Engineering Course at Purdue University.

Purdue University is about to inaugurate a new departure in connection with its general course of electrical engineering. This will be a course in telephone engineering, embracing the various scientific, technical and practical phases of this branch of electrical work. The course will be opened on February 1, 1902, and the junior and senior members of the school of electrical engineering will be required to devote a considerable part of their time to this subject. The department was added after very serious and careful consideration by the faculty and trustees of the university, and was designed to meet a growing demand for competent telephone engineers. The course, when established, it is believed, will be the first of its kind in the world. The material, appliances—consisting of various parts of telephonic systems—switchboards of all the well-known types, including those adapted for distributed and common battery service, multiple and express systems, etc., have been installed in the Electrical Engineering Building, and Professor J. C. Kelsey has been appointed in charge of the new department, under Professor W. E. Goldsborough, who has general charge of the courses of electrical engineering in Purdue University.

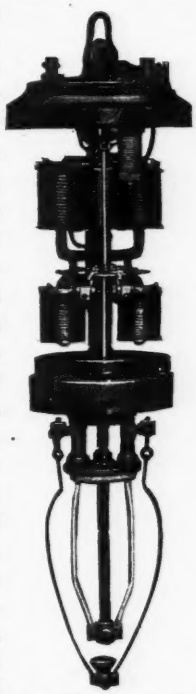
The advanced position that has been taken by the course of electrical instruction at this university has met with the very general and widespread approval of electrical engineers who have been familiar with its details. Under the able management of Professor Goldsborough the course has grown to be one of great importance, and large numbers of students are now availing themselves of the opportunities presented by it. It is interesting to note that the product of the course—that is, the young men who have graduated in it—have been almost uniformly successful in receiving excellent appointments in practical work.

Telephones on Trains.

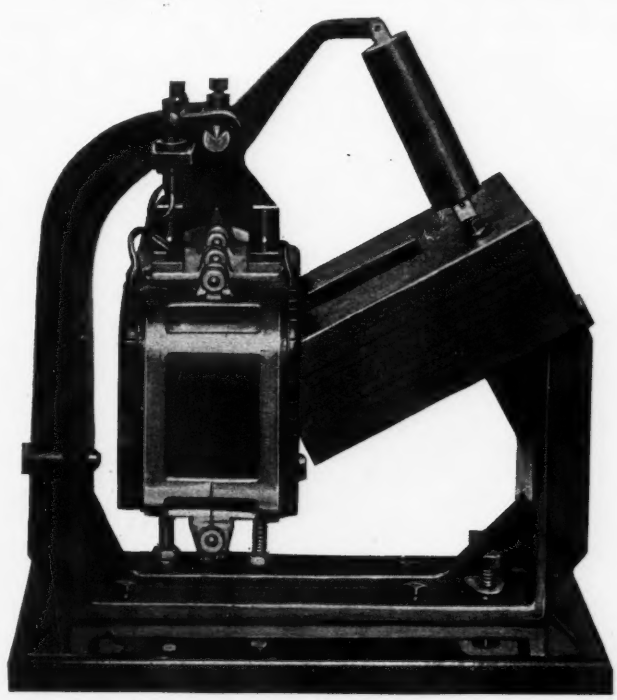
The practicability of having a complete telephone service on trains in transit has been demonstrated by President A. J. Cassatt, of the Pennsylvania Railroad. Telephones are to be placed on some of the regular passenger trains of the Pennsylvania system. The Chicago & Northwestern Railway also has telephones on its best trains, and when in stations connection is made with the regular city telephone service. Such telephone service should be of great use to the traveling public.

A New Series Alternating-Current Arc Lighting System.

Among the most interesting developments in the arc lighting field of recent years have been the various systems employing constant-current transformers or impedance coils of variable character to regulate alternating-current circuits for arc lighting. A new device of the impedance coil type has lately been brought out by the Helios-Upton Company, of Philadelphia, and is shown in the accompanying illustrations. The general method of operation is that making use of an impedance coil which automatically regulates the magnetic constants of its own magnetic circuit, and is arranged so that it may be used directly upon the primary circuit without transformation, if so desired. Simplicity has been carried to an extreme point in the construction of this instrument, which is excellently shown in the accompanying illustrations. The apparatus consists simply of two coils hung on a pivot so that they can swing up to one side so as to enclose more or less of a U-shaped iron core. The opposing force is the weight of the coil itself and, if necessary, a small auxiliary weight is used as an adjustment.



A New Arc Lamp.



Current Regulator.

The advantages claimed for this method of construction are that the instrument is made very compact and, on account of doing away with the counterweight which has been employed heretofore in instruments of this type, the inertia of the moving parts is made much less and its susceptibility to change of load greatly increased.

In connection with this regulator a differential type of lamp has been designed, employing a mechanical cutout. When this lamp is extinguished the carbons fall together and remain in that position until current is turned on, so that it is claimed the jarring to which such lamps are usually exposed will not in any way affect the certainty of the start. The differential lamp also has a certain advantage in assisting the regulation of the circuit, so that, as it is claimed by the maker, no oscillation of current can possibly occur with this system. While such a design imposes a small additional loss in the series coil, it is considered that this is of small importance compared with the excellent operating qualities which are attained.

The lamp consists of four coils mounted on a central tube, the series coils being above and the shunt coils below. These coils act on U-shaped, laminated-iron cores which are connected with a clutch lifting the carbons directly. To reduce series-coil losses the weight of the U-shaped plungers is counterbalanced.

It is claimed by the maker that this system is not designed to obtain the highest possible showing of economy and power-factor, but is made to work under difficult conditions of practice with certainty and satisfaction.

Chicago Electrical Notes.

(By Our Special Correspondent.)

THE UNION TRACTION Company, which operates 153 miles of interurban railway, running from Indianapolis to a number of towns and cities, has recently placed three "limited" cars on the Muncie-Indianapolis line. The cars leave Indianapolis in the forenoon and return in the afternoon, making but a single stop at Anderson. The distance is fifty-four miles and the schedule time is two hours. The trip from Indianapolis to Anderson, thirty-six miles, is made in one hour and sixteen minutes. The cars are always filled, which shows the public's appreciation of twentieth century electrical enterprise. These "limited" cars overtake freight trains on parallel steam lines and give the passenger trains a close race. The road is well ballasted, and the cars are equipped with all the conveniences of the steam railway cars.

Among the other new western traction lines to be constructed during the year 1902 is one running through the Indiana towns of Greensburg, Shelbyville and Batesville to Indianapolis. The articles of incorporation have been filed with the Secretary of State and the line will be known as the Greensburg, Shelbyville & Batesville Traction Company. A company of North Manchester (Ind.) capitalists has been formed to build an electric line through the town of Wabash from Kosciusko to Grout County lines. The length of the line will be twenty-six miles.

Down in Bloomington, Ill., the X-ray machine has been appealed to in a dispute between physicians as to diagnosis. W. E. Lash recently received certain injuries in an accident and is said to have placed himself under the treatment of a local physician who diagnosed his case as a transverse fracture of the femur, and treated him accordingly. The bill was paid, but the patient was informed by other physicians that he had not sustained such a fracture, whereupon he brought suit to recover the overpaid bill, and the X-ray was called in to show what had taken place.

A practical illustration of the use of the telephone as part of a diver's equipment is being given at the exposition which is being held at the Chicago Coliseum this week. A telephone is attached to a diver's helmet who is under water for a number of hours. Visitors to the show can converse with the man, and the device is proving quite an attraction. The telephone was used by divers in examining the wreck of the Idler, a private yacht from Cleveland, which went down on the lakes during the last season, thus enabling the men who were searching for bodies to keep those above promptly informed as to results.

News has reached this city of the passing of certain electric traction properties and franchises formerly owned by the Everett-Moore Syndicate into the hands of the Vanderbilts. The system as projected will embrace 2,000 miles and will parallel the Vanderbilt trunk lines from Buffalo to Chicago. The first passenger cars over that part of the system from Painesville, Ohio, to Port Huron, Mich., were sent over the line on December 9.

At Milwaukee an ordinance has been approved granting the Western Telephone and Telegraph Company the privilege of doing business in that city. The company proposes to construct an exchange and erect long-distance lines to Minneapolis, La Crosse, Madison and Chicago. It is said that the bonds of the company will be taken by one of the large Chicago trust companies.

Rumor is again reviving the scheme for building an elevated road in Chicago into the Englewood section of the city. Last spring an ordinance was introduced in council looking to the securing of such a franchise, but the names of the backers were kept secret and council did not act. At that time it was said that the promoters were eastern capitalists. It is now affirmed that Chicago money is behind the scheme.

The Mississippi River has become so low that the Twin City Rapid Transit Company is having trouble in securing sufficient power to propel its cars between Minneapolis and St. Paul, Minn. The company has started up its steam power-houses, but is still unable to secure the necessary power. The service has been cut down and the public has been caused great vexation. The reason for the lowness of the water is not clear. It may be due to the river running dry or to the damming up of logging streams which form tributaries to the upper Mississippi, thus cutting off the supply temporarily.

Chicago, December 14.

Metropolitan Street Railway Company, of New York.

On December 2 the following directors were reelected: H. H. Vreeland, P. A. B. Widener, D. B. Hasbrouck, H. A. Robinson, W. L. Elkins, Thomas Dolan, Charles E. Warren, Orrin Root, Jr., and D. C. Moorehead. President Vreeland stated that the contracts which exist at present for changing the motive power or construction of new roads terminated on December 15. From that time until the early spring no further work of this kind will be done. The work of changing the motive power on the Ninth avenue line from Fifty-third street to the foot of Cortlandt street will be begun in the early spring.

Annual Meeting of the Olympic Club.

The Olympic Club, probably the oldest club of New York city, which has a large membership among the electrical fraternity, held its annual meeting and banquet at Shanley's Roman Court, in New York city, on Monday evening of this week. The club's summer home, at Bay Shore, L. I., is one of the most attractive spots on Long Island. Mr. James Kempster, who has been president for the past two years, was unanimously reelected.

The banquet which followed was a highly enjoyable affair, closing with an entertainment of music, songs and variety sketches. Among the well-known electrical gentlemen present were Mr. Cyrus O. Baker, Jr., Mr. Henry L. Shippy, Mr. William D. Sargent, Mr. C. R. Bangs, Mr. E. F. Peck and Mr. E. C. Cockey.

The Electrical Trades Society.

The Electrical Trades Society, of New York, held its sixth annual meeting on December 10. At this meeting a number of the members were present and an address was made by the president, Mr. R. E. Gallagher. Interesting reports were read by the secretary, Mr. A. P. Eckert, concerning the work which had been done during the past year.

This society is in a flourishing condition and becoming more and more important as time passes. At present it has fifty-six members. The members are well satisfied with the work which the society is doing at the present time. The following officers were elected for the ensuing year: President, Mr. E. R. Gilmore, of the Western Electric Company; vice-president, Mr. H. A. Reed, of the Bishop Gutta Percha Company; secretary and treasurer, Mr. A. P. Eckert, of the Safety Insulated Wire and Cable Company.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

MICHIGAN POWER PLANT—It is said to be the plan to transmit electric power from the plant which is to be constructed at the rapids of the Muskegon River and Big Rapids to Grand Rapids, Mich.

MEXICAN PLANT TO BE OPERATED BY ELECTRICITY—It is reported that Srs. Hasan and Moreno, of the city of Mexico, are about to begin the construction of a rolling mill. This mill is to operated by electricity which will be generated by means of gas engines.

WIRELESS TELEGRAPHY IN THE RUSSIAN NAVY—The Russian Navy Department is said to have decided to equip Russia's warships with wireless telegraphy apparatus. The system of wireless telegraphy which was invented by Professor Popoff is to be the one installed.

BRAZILIAN ELECTRIC POWER AGITATION—It is said that the municipality of Rio Janeiro has approved plans for supplying electric power for industrial and other purposes. The power is to be generated from waterfalls located about forty-four miles from Rio Janeiro.

ST. LOUIS FAIR ELECTRIC PLANT—A plant to furnish 31,000 horse-power to the St. Louis Fair is to be installed. A number of the largest electrical concerns in the United States have entered bids for furnishing the equipment. The bids have been opened but the contract has not yet been awarded.

ELECTRIC RAILWAY IMPROVEMENTS—It has been announced that the Twin City Rapid Transit Company, of St. Paul, Minn., will spend $1,500,000 in improvements on its lines during the coming year. The lines are to be equipped with the continuous rail joint, and the small cars are to be done away with completely.

LARGE LONDON SECURITIES COMPANY—The Traction and Power Securities Company, Limited, which has a capital stock of $5,000,000, has been formed recently in London by Westinghouse interests. It is stated that the purpose of this company will be to handle the security and agency business of the British Westinghouse company.

ELECTRIC PLANT TO BE INSTALLED—A large electric plant is to be installed in connection with the new car shops of the New York, New Haven & Hartford Railroad, at Readville, Mass., where a large amount of the manufacturing and repairing is to be done in the future. This new plant will be used for lighting Readville and operating the machinery in the shops of the company.

MASSACHUSETTS RAILWAY UNITE—It is said that an arrangement has been made and approved by a majority of the stockholders of the Newton, the Newton & Boston, the Commonwealth Avenue, the Wellesley & Boston and the Lexington & Boston street railways by which a board of trustees, which acts under the name of the Boston Suburban Electric Companies, shall obtain and own most of the stock of these railways.

OHIO ELECTRIC RAILWAY NEWS—Articles of consolidation of the Tuscarawas Railway Company and the Tuscarawas Electric Company have been filed with the Secretary of State. These companies will be known hereafter as the Tuscarawas Traction Company, which has a capital stock of $350,000. It is supposed that this is a step toward the plan of the Mandelbaum-Pomeroy Syndicate which is acquiring control of the electric railways in southern Ohio.

LONDON CONTRACT AWARDED—Mr. Charles T. Yerkes has awarded the contract for the electrical equipment for the London underground railways to the British Westinghouse Electric and Manufacturing Company whose works are being built at Manchester, England, and will be in operation within a short time. The Pittsburgh works will cooperate. The generators in this plant are to be among the largest in the world. It is stated that the power station will have a minimum capacity of 70,000 horse-power and a maximum capacity of 100,000 horse-power.

A NEW ELECTRIC LETTER BOX—Mr. George DeGroat, who is connected with the post office in Morristown, N. J., has been granted a patent for a collectors' recording mechanism for letter boxes. By this device the boxes are locked, which prevents their being tapped during the night. By the electrical mechanism which is connected with the post office the carrier is permitted to open the boxes at the schedule hours in the morning and at the same time the time of opening is recorded in the office.

ELECTRICAL ACTIVITY IN SOUTHERN CALIFORNIA—It is said that the electric power plants which already exist in southern California, together with additions which have been contracted for and new plants which will probably be undertaken in the near future, will make available for use in Los Angeles and vicinity within a few years about 1,000,000 horse-power. There is great activity in the building of electric railways there at present and a number of pumping stations for purposes of irrigation are being installed, which, together with the various electric lighting companies, will make necessary an enormous amount of power.

MR. CARNEGIE TO ASSIST TELEGRAPH OPERATORS—It is said that Mr. Andrew Carnegie will now turn his attention to the aid of veteran telegraph operators, and that he will shortly have a conference with Colonel Albert B. Chandler, who is the chairman of the board of directors of the Postal Telegraph Company, regarding the best way to bring this about. When a young man Mr. Carnegie was a telegrapher on the old Atlantic & Ohio Railway, in Pittsburgh. It is said that three plans are to be laid before Mr. Carnegie, one for a pension fund, another for a home and hospital and another for a town to be erected on land in New York or in New Jersey.

NORTH RIVER TROLLEY TUNNEL—Mr. Edward F. C. Young, of Jersey City, N. J., who is president of the North Jersey Street Railway Company, controlling a number of trolley lines in the northern part of New Jersey, is reported to have announced that a trolley tunnel will be constructed in the near future under the Hudson River. It is stated that it is the intention of the company to complete the old abandoned North River tunnel, having terminals at Sixteenth street, Jersey City, and near Christopher street, New York, for this purpose. This tunnel was started over twenty-five years ago. A number of companies have taken up the matter of completing it, but owing to the difficulties encountered they have all given it up.

PENNSYLVANIA RAILWAY ELECTRIC LIGHTING ACTIVITY—It is said that the officials of the Pennsylvania Railroad lines west of Pittsburgh have decided to install an incandescent electric lighting system on all the passenger equipment service on the lines. The system that has been adopted furnishes light for each car equivalent to 300 candlepower. It is to be a storage battery system and the batteries are to be charged from power stations to be established in the different cities. It is the present plan to have stations in Pittsburgh, Chicago, Cincinnati, St. Louis and Columbus. A small generator will be placed at each station and there will be a reserve supply of batteries kept so that there will always be a supply of charged batteries at each station.

ELECTRIC LIGHTING

ST. HELENS, ORE.—An electric light plant has been installed at the Coburg Lumber Mill.

RANDOLPH, N. Y.—An electric light plant is to be installed at the factory of the Elko Paint Company.

POTTSDAM, N. Y.—The power for the electric lighting system is now furnished by the Hannawa Falls Power Plant.

SCOTTVILLE, MICH.—Arrangements have been made by the Stearns Power Company, of Ludington, to furnish electric lights. The work of stringing the wires will soon be begun.

PEEKSKILL, N. Y.—Good progress has been made in the construction of the power-house of the Peekskill Lighting and Railroad Company. The electrical machinery is now being installed.

BRAZIL, IND.—A number of improvements are being made by the Terre Haute Electric Company. The lines are being extended to enable it to furnish lights in additional parts of the city.

PENSACOLA, FLA.—The additional machinery has been installed in the plant of the electric light company. This machinery will be employed in supplying power for the arc lights which have been contracted for recently by the city.

NEW ROCHELLE, N. Y.—New Rochelle and the neighboring towns are being supplied with electricity from the plant of the Westchester Lighting Company. This power was formerly furnished from Mamaroneck and Mt. Vernon.

ORANGE, TEX.—The stockholders of the Orange Ice, Light and Waterworks Company have decided to sell bonds to the amount of $50,000, for the purpose of making a large number of additions to its equipment in different lines.

PITTSFIELD, MASS.—The Berkshire Street Railway Company, it is reported, will petition the legislature for permission to manufacture and sell electricity for light, heating and power purposes. By entering this field it becomes a competitor of the Pittsfield Electric Company, which now supplies electric power for these purposes.

LINCOLN, ILL.—Permission has been granted by the Secretary of State to a number of citizens to open books for soliciting stock to the Lincoln Heat, Light and Water Company to the extent of $50,000. Captain D. H. Harts and the Hon. Darlington Turnbolt are among those appointed for this purpose. The stock will be issued in shares of $25 each.

HELENA, MONT.—The Federal Court has been asked by the minority bondholders of the Helena Power and Light Company to allow them to intervene in the suit of the Central Trust Company, of New York, for the foreclosure of the mortgage on the property under which suit Mr. Harry L. Walker was appointed receiver. For this purpose a petition signed by a number of gentlemen has been filed.

DES MOINES, IOWA—The three commissioners, who were empowered by the act of the twenty-eighth town assembly to make investigations regarding the repairs and improvements needed upon the interior and exterior of the Capitol Building, have made their reports to Governor Shaw. Among other things recommended in this report is the expenditure for an electric lighting plant of $50,100, and for a burglar alarm telephone system of $2,500.

ELECTRIC RAILWAYS

BRUNSWICK, ME.—It is announced that the railroad commissioners have approved the location of the Brunswick & Portland Electric Railway.

AUSTIN, TEX.—Preparations are being made by the Austin Rapid Transit Street Railway Company to extend its lines to the eastern part of the city.

BUCYRUS, OHIO—The Pomeroy-Mandelbaum Syndicate has purchased the Ohio Central Traction Company, which was largely owned by people in New Haven, Ct.

AUGUSTA, ME.—Two contractors from Boston have been looking over the grading which will be necessary for the construction of the Winthrop & Augusta Electric Road.

OMAHA, NEB.—Mr. Guy C. Barton has purchased all of the stock of the Metropolitan Street Railway Company. This company operated a line between Dundee and Omaha.

SEDALIA, MO.—The building of the electric railway from Sedalia to Marshall is being considered. The building of such a line would open up a fine coal mining country.

HAZLETON, PA.—Good progress is being made in the construction of the trolley line between Hazleton and Wilkesbarre. A large number of men are employed all along the line.

STRONG CITY, KAN.—Messrs. A. J. C. Seiker and D. Reifsnyder have acquired control of the Strong City Street Railway. The track and rolling stock are to be greatly improved.

WATERLOO, IOWA—An electric line between Waterloo and Denver will soon be completed. Tnis road is owned by the Waterloo & Cedar Falls Rapid Transit Company, and is twelve miles long.

GREENSBORO, N. C.—The work of building the power-house for the Greensboro Electric Company is being pushed along rapidly. It is expected that the machinery will be in place by January 1.

SYRACUSE, N. Y.—It is stated that the contracts for the construction of the line of the Syracuse & Oneida Lake Electric Railroad Company, between Syracuse and Oneida Lake, have been awarded.

GOSHEN, IND.—A petition to be presented to the county commissioners is being circulated for holding an election to vote a subsidy for building an electric road to connect Fort Wayne and Goshen.

DAYTON, OHIO—It is stated that the work of constructing the Ft. Wayne, Dayton & Cincinnati Traction Company's line will soon be begun at West Elkton. Dr. Samuel F. George is the president of this company.

SAN FRANCISCO, CAL.—Articles of incorporation for a ferry system between Oakland and San Francisco have been filed. An electric tunnel railway from Oakland to Goat Island was included in the articles.

BOULDER, COL.—Enough money to put the Boulder Railway and Utility Company out of debt has been raised by Boulder capitalists. It is said that the company will soon extend its lines and make needed improvements.

SOUTH ESSEX, MICH.—The Everett-Moore Syndicate has purchased the charters and rights of the South Essex Electric Railway Company. The charter permits the construction of a railway from Windsor to Pelee Point.

EXETER, N. H.—Mr. W. W. Woodman has been elected president of the New Hampshire Traction Company, which is composed of the Exeter, Hampton and Amesbury system of electric railways, with a capital stock of $1,000,000.

BETHLEHEM, PA.—A survey for a trolley road from Bethlehem to Quakertown is being made. This railway is for the purpose of cutting off ten miles of the Johnson line between Allentown and Philadelphia, and opening a short route between Easton and Philadelphia.

LOUISVILLE, KY.—The directors of the Louisville & West Point Electric Railway recently held an important meeting. It is said that the right of way from Louisville to West Point has been secured and that large subscriptions for the capital stock have been received.

DAYTON, OHIO—Plans are being made for increasing the stock of the Fort Wayne, Dayton & Cincinnati Electric Line from $1,000,000 to $5,000,000. Ground will soon be broken at West Elkton by the company upon the southern division which extends from Fort Wayne to Cincinnati.

SILVER CITY, N. M.—A franchise has recently been granted by the city council to Messrs. Lucius Demming and T. M. Carter, of New Haven, Ct., and M. W. Porterfield, of Silver City. This franchise gives them permission to build a line of electric railway to connect the adjacent mining camps with Silver City.

NEWTOWN, PA.—The control of the Newtown-Yardley Trolley Company has passed into the hands of the Lehigh Valley Traction Company. This company had been planning to construct a road from Newtown to Yardley and thus connect the Newtown Electric Street Railway with the Yardley-Morrisville Road.

ST. LOUIS, MO.—The St. Louis County Court has granted a franchise for the building of an electric railway from St. Louis to Manchester, in St. Louis County. The company which is to build this railway is known as the St. Louis, Kirkwood & Manchester Railroad Company. Mr. D. C. Taylor is the president of the company.

PETERSBURG, VA.—The Richmond & Petersburg Electric Railway Company has received permission from the South Side Railway and Development Company to run its cars on the tracks of the latter company into Petersburg. It is expected that the Petersburg Electric Railway Company will soon begin running cars from Richmond to Petersburg.

STOUGHTON, WIS.—The Madison-Janesville Interurban Electric Railway Company has received a franchise from the common council to operate within the limits of Stoughton. Mr. P. L. Spooner, who is the president of the company, states that this completes the list of cities from which franchise rights were asked, and that the railway will now be constructed.

CHEVY CHASE, MD.—The Chevy Chase & Kensington Railway, connecting the town of Kensington with the northern terminus of the Chevy Chase line of the Capital Traction Company, was offered for sale by the receivers. The highest bid received was for $10,000, and the receivers decided to withdraw it. It is said to be the intention of the receivers to operate the road and perhaps to offer the property for sale at a later date.

TRENTON, N. J.—The incorporation of the Trenton & New Brunswick Railway with a capital stock of $1,000,000, which took place recently in Trenton, is said to be part of a plan to build a third-rail system between New York and Philadelphia. The part which has been incorporated is about twenty-three miles in length and would be an important part of the main line. It is stated that this road will be laid with heavy rails and will be rock ballasted. It will also be upon a private right of way, and there will be as few grade crossings as possible.

TELEPHONE AND TELEGRAPH

VICTOR, IOWA—A new telephone line is being constructed between Ladora and Victor.

DEER LODGE, MONT.—A telephone system is being installed by the Rocky Mountain Bell Telephone Company.

MOLINE, ILL.—The Illinois Independent Telephone Company has received a franchise from the city council permitting it to build a system.

AURORA, ILL.—The Chicago Telephone Company has received from the board of aldermen a franchise which gives it the right to lay underground conduits for its wires.

PLANT CITY, FLA.—The line of the Southern Bell Telephone and Telegraph Company from Tampa to Plant City has now been completed. It is expected that the line will be continued to Lakeland and then to Bartow.

EVANSVILLE, IND.—The Eureka Telephone Company has applied to the board of public works for permission to operate in the city. In return for a franchise this company will furnish a complete patrol system and place telephones in the public buildings of the city free of charge.

PRINCETON, IND.—Work has been begun by the Independent Telephone Company, which is composed of Chicago and local men. The headquarters of the company for southern Indiana are to be located in Princeton. All the adjacent towns are to be connected by long-distance wires.

IRON HILL, MD.—The line of the Maryland Telephone Company has been completed from Iron Hill to the Susquehanna River. The Susquehanna River will be crossed by the lines of this company, which will connect with its line on the Hartford shore by erecting towers above Perryville.

LYONS, N. Y.—The Eastern Electrical Construction Company, of Philadelphia, Pa., has acquired the Lyons Telephone Company and the Wayne Telephone and Telegraph Company. All the rights, privileges and franchises, trunk lines and local exchanges owned and controlled by H. P. and S. E. Bishop, of Clyde, are also included.

PORT DEPOSIT, MD.—A line from Port Deposit to Rising Sun has been completed by the Diamond State Telephone Company, which now controls a large number of the telephone lines on the eastern shore of Maryland. The cable of this company across Chesapeake Bay, between Love Point and the Anne Arundel shore, has not yet been completed, the cable having broken several times.

WINONA, MINN.—Representatives of the Rapid Service Telephone and Telegraph Company, the Winona Independent Telephone Company and the La Crosse Independent Telephone Company have made arrangements for telephone connections between the companies. It is said that the Rapid Service Telephone and Telegraph Company will complete a direct line to Chicago. In that case it would become a competitor for the business between Chicago and St. Paul.

BOSTON, MASS.—The instrument report for the American Telephone and Telegraph Company for the month ending November 20 shows a total outstanding of 2,467,966 instruments. As two instruments are required for each telephone this would make a total number of telephone sets of one-half that number, or 1,233,983. Probably 200,000 of these instruments are carried in stock by the licensee companies, or used on private lines, which would make about 1,000,000 as the total number of telephone subscribers of the Bell interests.

ELECTRICAL SECURITIES

The feature of the week has been, of course, the spectacular performances of Amalgamated Copper shares. Of all the various rumors that have been current and the numerous theories that have been advanced to account for the decline of this stock, perhaps the safest and most conservative view credits it to the contraction of the copper market itself, with its necessary sequence of falling prices of the actual metal. The price of copper has been so high for some time past as greatly to discourage the consumption of the metal and actually to force the substitution of other materials of construction wherever this has been possible. The evident result is that the price of copper has come down to a point determined by the conditions of demand and supply, and with this decrease in price comes the natural decrease in the value of the Amalgamated Company's securities.

The somewhat depressed tone of the market has not been entirely due to the falling off of this single stock, however. At present the country finds itself in the position of a debtor to Europe and large shipments of gold are going abroad, both in order to meet bills falling due at the first of the year and to pay off the American securities which were liberally sold in this country during the autumn by foreign holders. While the market has shown itself generally weak and somewhat depressed, there is absolutely no occasion to entertain any pessimistic feelings regarding the outlook since the position of the country materially is as good as it possibly can be and the outlook is cheerful and certain. Perhaps the wisest view is that readjustment necessarily and naturally follows over-expansion, and that the present apparent decrease in values is simply a readjustment to bring things back to the stable level of ordinary business, which was disturbed by the revolutionary advances and general inflation of value of last summer.

ELECTRICAL SECURITIES FOR WEEK ENDING DECEMBER 14.

New York:	Closing.
Brooklyn R. T.	62⅝
Con. Gas	215½
Gen. Elec	282
Man. El	132½
Met. St. Ry	158⅞
Kings Co. Elec	185
N. Y. & N. J. Tel. Co	166
Telep., Tel. & Cbl. Co	6½

The Manhattan Elevated Railway is now carrying at the rate of 22,000,000 passengers annually and is earning nearly 6 per cent on its present capital of $48,000,000. This is with the present equipment and has no relation to the possible advances that may be made when the electrical equipment is put to work.

For the four months ending October 31, the Brooklyn Rapid Transit Company is stated to have lost about $147,000 in net earnings. It is not believed that there will be much, if any, surplus this year on account of increased expenses for improvement of the property, and dividends are not looked for.

The Westinghouse Air Brake Company has declared a regular quarterly dividend of 2½ per cent and an extra dividend of 3½ per cent.

The report of the Western Union Telegraph Company's earnings for the December quarter shows a satisfactory gain over last year, the net increase in revenue being more than $137,170. The earnings on the stock were 1.6 per cent. These earnings give a margin over the dividends sufficiently large to strengthen confidence in regard to the maintenance of the 5 per cent rate.

Rumors are current that in the last two or three years a notable accumulation of General Electric stock has been gathered in the hands of a few people who are closely identified with the company. During that time the stock has risen from 70 to 280 in value. It is not possible to obtain official information respecting the intention of the managers to restore the capital written off in 1898.

Boston, December 14:	Closing.
Am. Telep. & Tel	160
Erie Tel	18
New Eng. Tel	133
Mass. Elec. pf	94
Westing. Mfg. pf	73½
Edison Elec. (rights)	3½

The Erie Telephone system report shows a total of subscribers connected November 30 of 160,575, a net gain of 2,237 subscribers.

A dividend rental of $2 per share will be paid by the Boston Elevated Railway Company to holders of West End preferred stock on January 1, 1902. The transfer books were closed on December 18.

An analysis of the annual report of the Massachusetts Electric Companies show an earning of 2½ per cent on the $14,000,000 of common stock outstanding. A very large sum was charged off during the year for operating expenses and it is not believed it will be necessary during the current year to make such large charges on this account.

Chicago, December 14:	Closing.
Central Union Tel	40
Chicago Edison Light	158
Chicago Telep	240
Metropolitan El	90½
National Carbon	19½
National Carbon pf	83
Union Traction	10½
Union Traction pf	47

It is reported that a large New York house is backing the Illinois Telegraph and Telephone Company, which owns a franchise to operate an automatic telephone system in New York, and which now has a most elaborate system of conduits in course of construction. This company, it is said, will compete with the Chicago Telephone Company, which is the Bell licensee.

The Twin City Rapid Transit Company has declared a quarterly dividend of 1¾ per cent on its preferred stock, payable January 2. Books close December 23 and reopen January 2.

Philadelphia, December 14:	Closing.
Elec. Co. of America	6
Philadelphia Elec	4⅝
Union Traction	32
United G. I. Co	114
Elec. Stor. Bat. c	60
Elec. Stor. Bat. pf	60

The Philadelphia Company, of Pittsburgh, which operates and owns the electric light and street railway interests of that city, has declared a regular quarterly dividend of 1½ per cent on its common stock payable January 15 to holders of record December 20.

PERSONAL MENTION

CAPTAIN S. J. WRIGHT has prepared to extend his telephone line from Kiomache to Towson, I. T.

MR. HERBERT H. DOW and others, of Midland, Mich., have secured a thirty-year franchise for an electric railway from St. Louis to Bay City.

MR. W. V. CONNS, who represents a Cleveland syndicate, has purchased the La Salle-Peru Street Electric Railway which extends from La Salle, Ill., to Peru.

MESSRS. F. J. MASON AND JAMES NOLAN, who have the contract for the construction work of the Home Telephone Company, in Toledo, Ohio, are there at present. The work of construction is to be pushed rapidly.

MR. C. A. COOK, who is the manager of the exchange of the Missouri & Kansas Telephone Company, in Anabel, Mo., states that a long-distance connecting office at Macon has been established and a fine switchboard installed.

MR. LELAND HUME, who is the general manager of the Cumberland Telephone Company, has just completed the inspection of the exchanges at a number of important towns in Kentucky. It is reported that the company's business has largely increased.

MR. A. P. JENKS, for some time past associated with the New York publication office of the General Electric Company, has lately been promoted to a responsible position in connection with the railway engineering department of that company, at Schenectady. Mr. Jenks's many friends in New York will regret the removal of the scene of his activities.

MR. U. N. BETHELL, general manager of the New York Telephone Company, has been elected president and general manager of the Chesapeake & Potomac Telephone Company, with headquarters in Baltimore. Mr. Bethell is one of the progressive and well-informed telephone men of the day and the interest of the organization over which he is called to preside will be advanced and developed under his able administration.

MR. DAVID YOUNG has resigned as president of the Elizabeth, Plainfield & Central New Jersey Street Railway Company. Mr. Young will now devote his time to the presidency of the Jersey City, Hoboken & Paterson Street Railway Company and to the vice-presidency of the North Jersey Street Railway Company. Mr. Alfred Barr will now have charge of the Elizabeth, Plainfield & Central New Jersey Street Railway Company. Until recently Mr. Barr was connected with the traction lines of Worcester, Mass.

OBITUARY NOTICE

MR. EDWARD J. MATHEWS, who was president of the American District Telegraph Company, was recently thrown from his horse and killed. At the time of his death Mr. Mathews was returning to his country residence at Valley Forge, Pa., from the Radnor Hunt breakfast at Chesterbrook Farm. The accident happened almost opposite the gateway of Mr. Mathews's home. Mr. Mathews was born in Philadelphia in 1836. He was educated at the West Philadelphia Institute and at the Franklin Institute. He had been a prominent figure in a number of companies, and about five years ago was elected to the presidency of the American District Telegraph Company.

AUTOMOBILE NOTES

PARIS AUTOMOBILE SHOW—The international exhibition of automobiles has been opened by President Loubet. A very large number of people were present, which included members of the Jockey Club and the Rue Royale. In the exhibits of the Minister of Posts and Telegraphs were two types for use between urban post offices and in transit to railway stations. The number of vehicles exhibited is very large.

AROUND THE WORLD IN AN AUTOMOBILE—It is said that Mr. Max Trudelier, a German, and five English and French sportsmen are to make a tour of the world in an automobile. A start will be made from Paris and the journey will be continued overland to the Chinese coast, where a steamer will be taken for San Francisco. Then the course will be across the American continent to New York. For this journey a 30-horse-power machine is to be used.

INDUSTRIAL ITEMS

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising its special five-magnet generator type, number thirty-six telephone, for heavily loaded or poorly constructed farmers' lines. It claims that they will ring under very adverse conditions.

THE ROCKWOOD MANUFACTURING COMPANY, Indianapolis, Ind., is unable to meet the demand for the paper pulleys which it manufactures. It has recently finished a pulley the weight of which was 4,000 pounds, to be used in connection with a 3,000-horse-power machine.

THE STERLING ELECTRIC COMPANY, of La Fayette, Ind., has, in two years just ended, quadrupled in size. Its factory is now one of the largest and best equipped in the country, and the effort of the company is to make the word Sterling applicable to every bit of apparatus which it turns out.

THE VARNEY ELECTRICAL SUPPLY COMPANY, of Indianapolis, Ind., has recently added a telephone department, and is finding the demand brisk for switchboards, telephones and general telephone supplies. The company's purpose is to overlook no detail which will add to the efficiency and long life of its output.

THE ANDERSON TOOL COMPANY, Anderson, Ind., has made some further improvements in its arc lamps. The company claims for this lamp simplicity in construction, durability of every part, elegance of finish, and graceful design. The business is rapidly increasing, and sales are giving universal satisfaction.

A. E. BURLAND & COMPANY, of Newport, R. I., have received many compliments on the electrical decorations for the policemen's ball which was recently held in Providence. The decorations were very beautiful, consisting principally of different figures which were produced by using a large number of different colored electric lights.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., has issued a booklet in which the merits of its single-phase alternating-current motors are set forth. The same company has issued a very neat calendar, on the back of which the switchboards, ammeters and voltmeters manufactured by this company are described.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, Ind., is having plans for a new factory building drawn which will give three times the space at present used. The new building will be located some distance from the heart of the city near the Bill Line tracks. Meantime the company has been obliged to make some additions to the building now occupied by it.

THE D. M. STEWARD MANUFACTURING COMPANY, of Chattanooga, Tenn., reports large demands for its lava insulators, and that during the present season it has been crowded beyond its capacity to fill its orders and forced to make some extensive enlargements in its plant. Since this firm was established, in 1876, the demand for the lava insulators has increased steadily.

THE OKONITE COMPANY, 253 Broadway, New York, is working a night force to take care of large orders that have accumulated. The factory of the company at Passaic, N. J., is crowded with orders. The demand for this high-grade insulated wire is constantly increasing and the business of the year 1901 will be one of the largest in the history of the company, and advance orders indicate that 1902 will show an increase over any previous year.

ALL THE BOILERS in the Edison Electric Illuminating Company's plant at Paterson, N. J., have been equipped with the "Potter mesh" separator (dry pipe) and superheater. The owners state the steam at the outlet of the boilers has been improved fifty per cent as shown by calorimeter tests for dryness, and that the parties have no trouble with water in their steam engines. Messrs. James Beggs & Company, 9 Dey street, New York, are meeting with unqualified success with the "Potter mesh."

THE NATIONAL RAILWAY PUBLICATION COMPANY, 24 Park Place, New York city, which publishes the official guide of the railways and steam navigation lines in the United States, Porto Rico, Canada, Mexico and Cuba, has compiled much useful information in the December issue of this guide. Information concerning changes on 619 timetables, affecting not less than 15,846 trains, is published in this number. In this issue also the time of the arrival and departure of trains at not less than 28,000 stations is contained. This guide should be of great use to all who have occasion to travel extensively.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., offers a very desirable Christmas present for any one to make to an ambitious young man, who is making his way in the world, in the way of a scholarship in its schools, if this young man is one who has a taste for mechanics. This school has prepared an extremely neat handbook which is sent upon request. The value of this Christmas present will increase with every year of the life of the holder. It will open the way for him to become an expert mechanic and give him a knowledge of engineering, which will become more and more useful to him with the lapse of time.

THE HAINES & NOYES COMPANY, Chicago, Ill., which manufactures telephone apparatus, announces the appointment of the following agencies: Gilson & Hatch, Lynn, Mass.; G. R. Mathieu, 6,000 Hoeveler, street, E. E., Pittsburgh, Pa.; C. K. Hill, 210 Seventh street, Pittsburgh, Pa.; Roak & Rittenhouse, 723 Walnut street, Philadelphia, Pa.; Federal Electric Company, export agent, New York city; Risley & Boniface, 109 South New York avenue, Atlantic City, N. J.; J. E. Henry & Company, Baltimore, Md.; H. I. Sackett, Builders' Exchange, Buffalo, N. Y.; J. A. Erner & Company, Permanent Building, Cleveland, Ohio; Porter Bros., Louisville, Ky.; Jas. Clark, Jr. & Company, Louisville, Ky.; W. T. Osborn & Company, Kansas City, Mo.; Overton Manufacturing Company, Topeka, Kan.; Portland General Electric Company, Portland, Ore.; Woodill & Hulse Electric Company, Los Angeles, Cal.; The John M. Klein's Electrical Works, San Francisco, Cal.; Mr. Chas. W. Geib, Spokane, Wash.; Mr. T. W. Tugglem, Beaumont, Tex.; Mr. T. W. Rachford, Springfield, Ill.; Erickson Electrical Equipment Company, Boston, Mass.; Harry & Wood, Louisville, Ky. It has made Messrs. E. M. Van Duzee, Jr. & Company its agents for the northwestern states, with headquarters in St. Paul, Minn. Other agencies will be announced later. The Haines & Noyes Company has closed during the past month the following contracts through its private telephone plant department: The Manistee Iron Works, Manistee, Mich.; Story & Clark Piano Company, Grand Haven, Mich.; David C. Cook Publishing Company, Elgin, Ill.; College of Physicians and Surgeons, Chicago; Rush Medical College, Chicago; Wesley Hospital, Chicago; Evanston Hospital, Evanston, Ill.; St. Anne's Hospital, Chicago; Elmes Engineering Works, Chicago; Tampa Electric Company, Tampa, Fla.; Houghton County Street Railway Company, Hancock, Mich.; Blue Hill Street Railway Company, Milton, Mass. It has also supplied Armour & Company, of Chicago, with a large number of telephones, besides replacing a number of telephones that were formerly used. Through its agents the company has equipped a large number of business houses in Lynn, Mass.; Philadelphia, Pittsburgh, Louisville, Boston, Kansas City, St. Paul, San Francisco, Los Angeles, and other places. Besides these large plants it has equipped a number of private residences with telephone systems, as well as numerous apartment buildings throughout the United States.

NEW INCORPORATIONS

NEW SHARON, IOWA—The Farmers' Mutual Telephone Company. $4,500.

MT. JOY, PA.—Mt. Joy Electric Light, Heat and Power Company. $15,000.

CHICAGO, ILL.—The Chicago & Western Railway Company. Increased its capital stock from $10,000 to $100,000.

NEWBURGH, N. Y.—Moodna Light, Water and Power Company. $20,000. Directors: H. A. Pressey, H. J. Long and others.

RIDGE FARM, ILL.—Ridge Farm Electric Light, Heat and Power Company. Increased its capital stock from $5,000 to $10,000.

WICHITA FALLS, TEX.—Texas Telephone Company has filed an amendment to its charter, increasing its capital stock to $6,000.

LINCOLN, ILL.—Lincoln Heat, Light and Water Company. $50,000. Incorporators: W. A. Thomas, James W. Collins and others.

CHICAGO, ILL.—H. C. Dodge Electric Company. $1,000. To manufacture electrical supplies. Incorporators: M. I. Heldman and others.

SHERRARD, ILL.—Sherrard Telephone Company. $2,500. To operate a telephone system. Incorporators: J. C. Vernon, L. R. Trego and others.

NEW YORK, N. Y.—The Prometheus Electric Company. $500,000. Directors: B. T. Lynch, Brooklyn; S. G. Stewart and George Russell, New York city.

BELVIDERE, PA.—Phillipsburg & Washington Street Railway Company. $1,000,000. To build a trolley line from Phillipsburg to Washington. Incorporators: C. M. Bates, Robert E. Wright and others.

ARKADELPHIA, ARK.—Wilson Water and Electric Company. $75,000, which has been subscribed. The officers are: J. W. Wilson, president and treasurer; J. H. Crawford, vice-president; Josiah Hardage, secretary.

WHEELING, W. VA.—Charleston Water, Gas and Electric Company. $1,000,000. For the purpose of owning and operating water, gas and electric light works in Charleston and the surrounding country.

CHATTANOOGA, TENN.—The City Telephone Company. $50,000. To construct and operate telephone and conduit systems in Chattanooga. The incorporators are: S. Erwin, J. B. Whitehead and others.

HARRISBURG, PA.—Minisink Railroad Company. $60,000. To build a trolley railway from the court house, in Stroudsburg, to Portland via Delaware Water Gap. Incorporators: W. and J. Bray, A. O. Allen and others.

MADISON, WIS.—The Shawno, Green Bay & Interurban Railroad Company. $100,000. To connect Shawno, Green Bay, Appleton, Wausau and intervening points by an electric line. Incorporators: P. G. Dreuer, Louis Roltmann and others.

PHILLIPSBURG, N. J.—Phillipsburg & Washington Street Railway Company. $500,000. To extend the trolley line from Phillipsburg to the cement industries at Alpha, Vulcanite and Washington. Incorporators: Robert E. Wright, of Allentown, Pa.; C. M. Bates, of Brooklyn, N. Y., and others.

LEXINGTON, KY.—Blue Grass Consolidated Traction Company. $7,000,000. To construct electric railways from Lexington to surrounding county seats. The company will absorb the Blue Grass Traction Company which secured the necessary franchises for the system. Incorporators: H. C. Beatty, George B. Davis and others.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED DECEMBER 10, 1901.

688,282 Electric switch; C. A. Bergstrom, New York, N. Y.

688,291 Electric storage battery; W. J. Buckley, Chicago, Ill.

688,293 Telephony; G. A. Cardwell, New York, N. Y.—The method of reenforcing the effect of the main-line current upon microphone contacts by causing variations of current in a local circuit which influences the main-line magnet independently of the main line to correspond with the variations of current in the main line.

688,304-305 Apparatus for operating alarms or other devices; F. Grinnell, New Bedford, Mass.

688,317 Winding for electric machines; B. G. Lamme, Pittsburgh, Pa.—A winding for electrical machines comprising a plurality of coils, one half of which have offset bends at one end of the core and the other half of which have similar offset bends at the other end of the core.

688,318 Winding for electrical machines; B. G. Lamme, Pittsburgh, Pa.

688,337 Means for electrically connecting railway cars; E. B. Reichel, Berlin, Germany.

688,340 Direct-current dynamo-electric machine; A. Rotth, Berlin, Germany.

688,359 Circuit-breaking apparatus for electrical circuits; L. B. Stillwell, Niagara Falls, N. Y.—A system of electrical distribution comprising a plurality of feeding or distributing circuits supplied from one set of bus-bars, a circuit-breaker for each circuit having means actuated by excessive current of normal direction to effect its release and having means for prevent-

(Continued on page 38.)

The Handsomest Calendar

of the season (in ten colors), six beautiful heads (on six sheets, 10x12 inches), reproductions of paintings by Moran, issued by General Passenger Department, Chicago, Milwaukee & St. Paul Railway, will be sent on receipt of twenty-five cents. Address F. A. Miller, General Passenger Agent, Chicago.

The Charleston Exposition.

REDUCED RATES VIA THE PENNSYLVANIA RAILROAD.

During the continuance of the South Carolina Inter-State and West-Indian Exposition, to be held at Charleston, S. C., from December 1 to June 1, the Pennsylvania Railroad Company will sell excursion tickets to Charleston and return from all points on its line at reduced rates. These tickets will be sold daily from November 30 to May 31, and will be of two descriptions: Season tickets, bearing a final limit of June 3, 1902, and eleven-day tickets, good to return within eleven days, including date of sale, but not good after June 3, 1902. These tickets will not be good to stop off *en route*. For rates and further particulars apply to Ticket Agents.

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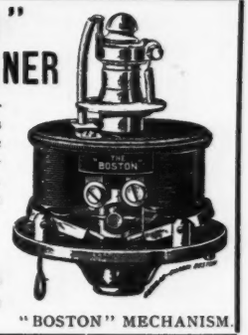

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E. C. Hathaway, General Manager.

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PATENTS.

(*Continued from page 37.*)

ing its release when subjected to reverse current.

688,364 Electric furnace; E. R. Taylor, Penn Yan, N. Y.

688,382 Mechanism for transmitting power to dynamo machines; Otto Bohm, Oberschonweide, Germany.

688,393 Electric furnace; R. C. Contardo, Sevres, France.

688,394 System of electrical distribution; J. L. Cheveling, New York, N. Y.

688,401 Electrical apparatus; J. E. Everett, Indianapolis, Ind.

688,403 Electric battery; G. W. Frazier, Allegheny, Pa.

688,423 Commutator brush-holder; H. J. W. Lloyd, Des Moines, Iowa.

688,433 Telephone receiver; F. J. Orr, Holland, N. Y.—A permanent magnet, a metal plate arranged over the poles thereof and secured at its centre and at points at its edge, an electromagnet secured to said plate and having its core resting movably against the permanent magnet, and a diaphragm arranged forward of the electromagnet.

688,452 Telephone exchange system; H. G. Webster Chicago, Ill.

688,456 Electromechanical automatic street railway switch; W. J. Bell, Los Angeles, Cal.

688,458 Stereoscopic X-ray apparatus; E. W. Caldwell, New York, N. Y.

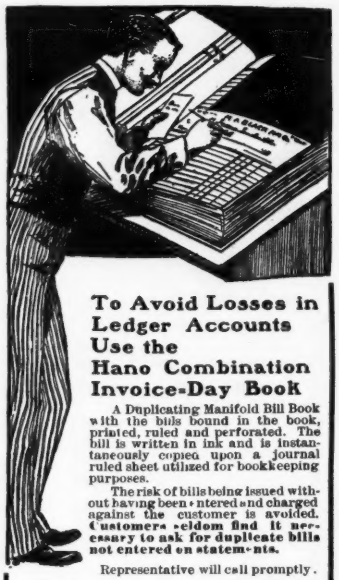
(*Concluded on page 40.*)

WANTED—SEVERAL PERSONS of character and good reputation in each state (one in this county required) to represent and advertise old established wealthy business house of solid financial standing. Salary $18.00 weekly with expenses additional, all payable in cash each Wednesday direct from head offices. Horse and carriage furnished, when necessary. References. Enclose self-addressed stamped envelope. Manager, 316 Caxton Building, Chicago.

Pennsylvania Railroad Company will Issue Clerical Orders for 1902.

The Pennsylvania Railroad Company announces that clerical orders will be issued for the year 1902 to ordained clergymen having regular charge of churches located on or near the line of its road.

Application blanks may be obtained of ticket agents, and same should reach the General Office by December 21, so that orders may be mailed December 31 to clergymen entitled to receive them. Orders will be issued only on individual application of clergymen when made on blanks furnished by the Company and certified to by one of its agents.



To Avoid Losses in Ledger Accounts Use the Hano Combination Invoice-Day Book

A Duplicating Manifold Bill Book with the bills bound in the book, printed, ruled and perforated. The bill is written in ink and is instantaneously copied upon a journal ruled sheet utilized for bookkeeping purposes.

The risk of bills being issued without having been entered and charged against the customer is avoided. Customers seldom find it necessary to ask for duplicate bills not entered on statements.

Representative will call promptly.

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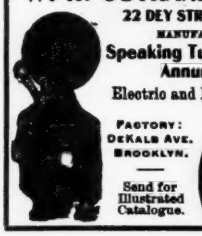

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Send for Illustrated Catalogue.

Personally-Conducted Tours via Pennsylvania Railroad.

SEASON OF 1901-1902.

The Pennsylvania Railroad Company announces the following Personally-Conducted Tours for the season of 1901-1902:

Mexico and California.—A forty-five-day tour will leave New York, Philadelphia and Harrisburg February 11. The party will travel over the entire route by the "Mexico and California Special," the finest train that crosses the continent.

Florida.—Three tours to Jacksonville will leave New York and Philadelphia February 4 and 18, and March 4. The first two admit of a stay of two weeks in the "Flowery State." Tickets for the third tour will be good to return by regular trains until May 31, 1902.

Old Point Comfort, Richmond and Washington.—Seven tours will leave New York and Philadelphia December 28, February 1, March 8 and 22, April 5 and 19, and May 3.

Old Point Comfort.—Seven tours will leave New York and Philadelphia December 28, February 1, March 8 and 22, April 5 and 19, and May 3.

Washington.—Seven tours will leave New York and Philadelphia December 26, January 30, February 20, March 6 and 25, April 17, and May 1.

For detailed information apply to Tourist Agent, 1196 Broadway, New York; 860 Fulton Street, 4 Court Street, Brooklyn; 789 Broad Street, Newark, N. J.; or Geo. W. Boyd, Assistant General Passenger Agent, Philadelphia.

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THE MOST PERFECT AND RELIABLE . . .
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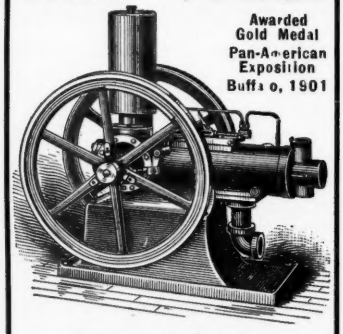

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Automatic, Simple and Reliable. Close Regulation.
For Electric Lighting, Charging Storage Batteries and all power purposes. Send for Catalogue.
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Over **600** of these **SYSTEMS** in use on many of the largest plants in this country. With the use of the MONARCH SYSTEM it is impossible for an engine to run away; engine can also be stopped, in case of emergency, from any portion of the plant by pressing an electric button. **NO CONNECTION WITH THE GOVERNOR. IT CLOSES THE THROTTLE.** INVESTIGATE. Write for Illustrated **1901** Catalogue.

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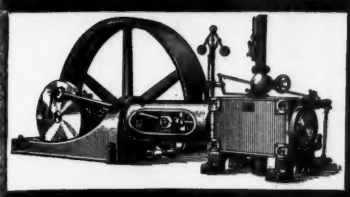

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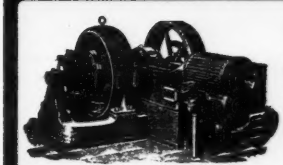

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PATENTS.

(*Concluded from page 38.*)

688,480 Electric lamp and socket therefor; D. D. Nugent, Harrison, N. J.

688,494 Thermo-electrodynamic transformer; P. K. Stern, New York, N. Y.

688,506 Electrical controller attachment; G. L. Fairbrother, Thompsonville, Ct.—Consists of a plate adapted to be placed upon a controller about the spindle, bolts loosely held by the plate, a spring for causing the bolts to project outwardly from the plate into the path of a part of the controller handle, and a lever attached to the controller handle adjacent to the ends of the bolts.

688,554 Circuit-making and breaking device; J. F. Skirrow, East Orange, N. J.

688,572 Electric railway; F. M. Ashley, Brooklyn, N. Y.

688,575 Electric arc lamp; H. Baggett, Blackheath, England.

688,583 Electric knife-switch; W. F. Bossert, Utica, N. Y.

688,614 Regulator; A. R. Everett, Lynn, Mass.—A plurality of fixed contacts in cooperative relation to a plurality of moving contacts having a common centre and arranged so as to pass each other, and means for simultaneously imparting movement to the contacts in opposite direction.

688,649 Electric arc lamp; C. H. Kayser, Orange, N. J.

688,650 Apparatus for measuring electrical energy; R. Kennedy, Leeds, England.

688 670 Magnetic friction brake; J. McGeorge, Cleveland, Ohio.

688,673 Telephone system; C. H. North, Cleveland, Ohio.

688,676 Telephone; W. S. Paca, Baltimore, Md.

688,724 Electric signaling device for railways; W. A. Farrell, Wellsville, N. Y.

688,738 Electric switch; J. Jones, New York, N. Y.

688,749 Storage battery cage or case; E. A. Sperry, Cleveland, Ohio.

688,781 Cutout for cranes; G. A. Hassel, McKeesport, Pa.

688,788 Primary battery; H. I. Lurye, New York, N. Y.

688,797 Electric railway switch; P. Siegel, New York, N. Y.

688,805 Alternating-current motor; E. Wilson, County of Kent, England—A field magnet and an armature, each of which is provided with one complete circuit having two pairs of terminals at right angles to each other and means for supplying currents differing in phase to said terminals.

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U. S. ENGINEER OFFICE, 735 N. Capitol St., Washington, D. C., November 27, 1901.—Sealed proposals will be received here until noon, December 27, 1901, and then publicly opened, for furnishing Elevator Enclosures, Automatic Elevator Door Openers, and Meaker or Rolling Shutter Doors, for New Building for Government Printing Office. Information furnished on application. JOHN STEPHEN SEWELL, Capt., Engrs.

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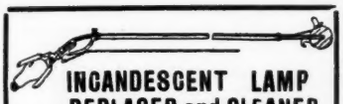
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